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BRIEFLY TOLD.

THE LOUISVILLE (KY.) GAS COMPANY SUSTAINED.—Judge Sterling B. Toney, of the Jefferson Circuit Court, of Jefferson County, Ky., has rendered a decision in the case of the Louisville Gas Company against the Kentucky Heating and Lighting Company, of Louisville, by virtue of which decision the contention of the plaintiff is sustained in every main point. Defendant, whose only claim to do business in the distributing of gas in Louisville is based on the chartered right to distribute natural gas for heating purposes only in that city, asserted that it was not responsible for what its patrons did with the gas they got. If the patrons used the gas for illuminating purposes, through the agency of a Welsbach burner or other converting medium, the Company was not responsible for such conversion. Plaintiff's counsel held that the defendant was not empowered, either in the letter or the spirit of its charter, to do other than supply natural gas for *heating* purposes only, and in such view the Court concurred. Of course, this is the first decision in the case, and the defendant will appeal; but the terms of the initial opinion are such as to cause independent observers to believe that the higher the legal resort the worse it will be for those making the pleadings of the Kentucky Heating and Lighting Company. In his conclusions Judge Toney had this to say: "It results from the foregoing views that the plaintiff's petition, in so far as it seeks to enjoin the defendant from selling and distributing natural gas, or a *compound* of natural and artificial gas called fuel gas, for illuminating purposes, by the use of the Welsbach burner or other mechanism, must be granted, and also the prayer of the petitioner to restrain the defendant from casting a cloud upon the plaintiff's title to the *exclusive* right of supplying illuminating gas in the city of Louisville for *illuminating* and *heating* purposes must be and is granted." The next step in this important litigation will not be delayed, and it will be considered with interest.

DEATH OF MR. HENRY RANSHAW.—With great regret we report the death of Mr. Henry Ranshaw, whose term of life ended June 30th last. Deceased, who was President and Manager of the Stacey Manufacturing Company, of Cincinnati, Ohio, had been identified with that concern since 1851, in which year he joined fortunes with the late Mr. George Stacey the father of Mr. Wm. Stacey in the formation of the firm of George Stacey & Co., the predecessor of the existing house. Mr. Ranshaw was a retiring sort of man in that he seldom figured publicly in the doings of the gas world, but his business course was that of one who, in asserting his own rights, was not unmindful that others were entitled to consideration.

THE CONTEST IN BALTIMORE CONSOLIDATED GAS.—The contest for the year's control of the affairs of the Baltimore Consolidated Gas Company, which contest was decided at the annual meeting of the shareholdders held last Monday, resulted in the election of the regular ticket, headed by Mr. Ferdinand C. Latrobe. His associates on the Board of Directors are Messrs. William W. Spence, W. F. Frick, John W. Hall, James A. Gary, H. R. Wilson, Frank Tilford, John E. Hurst, E. A. Jenkins, G. A. von Lingen, Bernard Chan and N. W. James. The contest was very close, the opposition ticket, presented

by Mr. Charles H. Dickey, receiving 39,902 votes to 47,165 votes polled by the regulars. In any event the shareholders of the Baltimore Consolidated Gas Company are to be congratulated over the contest, for through its waging they are bound to be benefited. It has for some time back been well known in gas circles that the management of the Company was not of the sort calculated to cause its business to grow, whether through an inclination to allow the local electric light company or companies to go on unmolested we are not prepared to say; but whether so or not, the fact is that Mr. Latrobe and his associates will have 12 months in which to show what they can do in the line of largely bettering the Company's trading. For Mr. Dickey and his friends are not inclined to forego another sortie; in fact the attack can only be prevented by the presentation of results showing that the Company has awakened well from its 8 years of lethargy.

NOTES.—The death of Mr. Henry Ranshaw, President and Manager of the Stacey Manufacturing Company, of Cincinnati, of course necessitated a rearranging of its executive direction. This has been effected in the naming of the following officers: President, William Stacey; Vice-President and General Manager, J. E. Stacey. Of course, Mr. R J. Tarvin continues as Secretary, and Mr. Thos. H. Birch goes on as Assistant Manager.——"Governor" Hayward has put in successful operation a "Western Branch" of the Connelly Iron Sponge and Governor Company, with headquarters at 788 South Canal street, Chicago. The branch is in charge of the "Governor's" son, Mr. S. P. Hayward; and if he does half as well as his father has done he will have no occasion to find fault with himself. He is a chip of the old block, if "hustling" is to count.——The proprietors of the Elizabethtown (N. J.) Gas Light Company have reduced the selling rate to $1.25 per 1,000 cubic feet net. Over 2,000 ranges are in use in Elizabeth and its suburbs, and Secretary Price and Superintendent Engel propose to add many more to the list before September 1st.

Acetylene Black.

An exchange says it is a well known fact that in all carbide works a vast amount of material is manufactured that is of such inferior quality that it cannot be employed in connection with acetylene, and so far has been regarded as waste. Now, however, a French engineer, M. Hubou, has invented a process by which he can convert this unsalable material into a commercial article in the form of acetylene black. When acetylene is decomposed the carbon is liberated in an absolutely pure and finely divided state. It is immeasurably superior to lampblack, and would prove a valuable substitute for that substance in the manufacture of lithographic ink were it not for the fact that it is so exceedingly expensive that it would not pay for its manufacture.

M. Hubou, by his new process, however, is able to convert the carbide residue into the black at a very small cost, so that it can compete in price with the ordinary lampblack. His process is simplicity itself. The acetylene is forced into an explosive vessel filled with hydrogen until a pressure of about 75 pounds is attained. The substance is then exploded by firing a coil of platinum wire that has been previously inserted into the vessel to a white heat. Owing to the presence of the hydrogen in the receptacle the heat generated by the acetylene in the process of decomposition is reduced, so that the highest pressure recorded during the explosion is no more than 370 pounds per square inch. One cubic foot of acetylene yields 1 ounce of black, while also a cubic foot of pure hydrogen is produced. There is no reason why the latter article should not also be turned to commercial account. It could be easily stored in cylinders and could be employed for æronautical and other purposes.

A New Theory Respecting Atmospheric Electricity.

A new theory of atmospheric electricity has been established independently by Messrs. Elster and Geitel, on one hand, and by J. J. Thomson and Wilson on the other. This theory is based on the properties of ionized gas. The solar light, and especially the ultra-violet rays, produce in the atmosphere the phenomenon known as ionization, giving rise to an equal number of ions charged positively and ions charged negatively. As these are in equal number in dry air, their charges do not develop an electric potential of an appreciable value; but when the air has been cooled below the dew point, it appears that the negative irons serve as nuclei for the condensation of the humidity into drops, and these, in falling, take with them the negative ions, soon leaving an excess of positive ions in the air. This causes a rise in electric potential due to the presence of these ions, and hence the electrical phenomena which accompany rain. A number of laboratory experiments have been made which seem to bear out this theory.

Modern Methods of Manufacturing Gas; with a Description of its Distribution Under High Pressure.[1]

[Abstract of a paper read by MR. FREDERICK H. SHELTON before the Engineers' Club, of Philadelphia.]

Before taking up the descriptive portion of the subject, it may be well to distinguish between the various gases that are commercially used, as many are apt to think that gas is gas, and that there is but one kind. We all know of natural gas—distributed in the West rather than in the East, and obviously not a manufactured product. We are also familiar with "producer gas," cheaply made and impossible to distribute to any considerable distance; used almost entirely in iron and steel manufacture and industries of that nature. It is not that kind to which I have reference to night; nor is it any of the special gases, such as the high candle power, pure oil gas, particularly adapted to fields involving very high compression, as when a large quantity of illuminating value stored in a very small receptacle is desired—for car lighting, for instance; nor am I referring to "fuel gases" of various kinds, sometimes nothing more than, literally, "greased air"—air charged with naphtha or benzene. I shall refer strictly and wholly to that gas which is known as illuminating gas, and which is distributed in all of our principal cities—in fact, in practically every city in the country of a population of 5,000 or over.

The manufacture of illuminating gas is a little over 100 years old. William Murdock, in 1792, in England, was the first one to serve his house and some of his neighbors with such gas, and he is known as the "father of gas lighting." Since his time innumerable methods of making and supplying illuminating gas have been suggested and more or less agitated. I presume that no other industrial art has had more worthless patents brought out.

Oil, for instance, is very volatile. A teapot containing a little oil put on a stove will apparently make "gas," and this easy vaporization and, therefore, apparently easy way of making gas, has resulted in more broken hearts and broken pocket books, and disappointments over exploded "process," than in almost any other field of work. The patent office record is full of worthless processes, of which but few have got a foothold commercially. The almost universal method of making gas, from the beginning and until comparatively recently, has been that which we all know as "the coal gas process." William Murdock used it; and some of the largest additions to gas plants to-day are upon this line. It consists, in brief, of the distillation of bituminous coal—soft coal. In the manufacture of coal gas, as distinguished from water gas (of which I will speak later), there are several steps which, while not all exactly distinct processes, are sufficiently so to make each a particular feature.

The disadvantages of the coal gas process are chiefly these: The cost of labor, a high repair account, and that there is practically no elasticity in the operation. The ovens will turn out about so much gas right along each 24 hours. One cannot speed them up for heavy demands, and when a series of dark days sets in, and the demand is increased 50 per cent., there is no easy or economical method of meeting it. The system is weak in that respect. Other defects are that coal gas takes a great amount of space for buildings; the investment is large. Furthermore, the quality of gas made by it is limited to about 18 or 20 candles. In all of these points the water gas system is superior, and the realization of it has caused it to replace the coal gas system to such extent that to day the former is used for two-thirds of the gas made in this country.

The making of water gas is based upon the theory, and interesting scheme, of producing by composition (making artificially, so to speak) a product similar to that obtained from soft coal; in other words, the making of hydrocarbons. If there be found a cheap source of hydrogen and another cheap source of carbon, and a good way of extracting these and of mixing permanently and in the right proportions, the result will be the same thing as that secured by distillation of soft coal. The water gas process does that. Steam is the base, and steam is water, hence the name of "water gas." The steam contains the hydrogen, it being one of the elements of the water. Thus we have in water—*i. e.*, steam—easily procurable, a supply of hydrogen, if we can get it away from the oxygen. In petroleum, or liquid hydrocarbon, we have an available supply of hydrocarbon. The principle upon which the making of water gas is based was known 100 years ago—that is, the fact that steam, in the presence of incandescent carbon, will decompose. The question, however, of how to separate the steam into oxygen and hydrogen, on any large scale, was practically a very difficult one,

1. From the "Proceedings," Engineers' Club.

and finally solved by the use of incandescent carbon in the form of coal. For half a century inventors tried to make gas by using steam, recognizing the weaknesses of coal gas manufacture. From 1800 to 1860 probably 60 patents were taken out. None of them, however, covered practical methods. Along in the 60's a little more success was attained. Steam was turned into existing retorts of coal gas benches, red hot coke was used for the carbon, with more or less oil, and some water gas was secured. This still had the slowness of the retort process, and most of the difficulties, practically, of making coal gas; it was only a half-way method of making water gas. It was not until 1872 that the first patent was taken out for the form of water gas process that has revolutionized the business. This was by Prof. T. S. C. Lowe, who is known as "the father of water gas." He was an aeronaut in the army during the Civil War. After the war he continued to study the manufacture of gases. He conceived the scheme of having a "generator," so called, resembling a large vertical boiler, consisting of a firebrick lined shell, and containing a bed of anthracite coal, which was first "blown up" by a forced draft to an incandescent state. Into this he then turned the steam, with the result that the steam in passing through the firebed became decomposed and hydrogen was set free. He took out a patent for this process in 1872, and another in 1875, and, as I have said, he evolved the right combination, as compared with the earlier plans, which were failures, for water gas made on his plan today includes two thirds of the illuminating gas made in this country. As it is a matter of considerable importance and vital to gas interests in these days, it is worth taking just a moment or two to describe the apparatus.

A vertical generator shell is provided with charging door at the top and grate at the bottom, with a hopper for the taking out of ashes; this shell is lined with firebrick, and is connected by a cast iron, goose-neck connection to a second shell standing in the rear also lined with firebrick, and has an outlet at the top to the stack. It is filled with checker brick, ordinary 4 by 9 inches firebrick, stacked up "dry" at right angles from top to bottom. The two vessels cover all the fundamental apparatus necessary for the manufacture of water gas. The generator or first vessel is filled full of carbon—that is, anthracite or coke—which is blown up to a white heat (taking about 10 minutes in regular operation) by an air blast which enters at the bottom. The products of combustion pass out through the connecting pipe into the second vessel (the charging door being closed) and, entering at the base, are therein burned (the products being carbon monoxide and nitrogen chiefly) by the admission of a second air supply, with the result of heating the firebrick stacked up in the second vessel. When hot enough, the air blast is shut off, the top or stack outlet is closed, and steam is turned in the base of the generator and passes up through the white-hot carbon or coal, with the result that two reactions take place. First, the steam is converted into hydrogen and carbon dioxide, and immediately a second reaction follows—the carbon dioxide turning into carbon monoxide. The resulting products are hydrogen and carbonic monoxide. Of course, putting two elements in the steam at the base, hydrogen and oxygen, and taking out the hydrogen at the top, we also have to account for the oxygen. The oxygen comes through in the form of carbon monoxide, the oxygen of the steam having united with the carbon of the coal. These two gases, carbon monoxide and hydrogen, burn with a blue flame, but practically have no lighting power. They, however, give us the combustible vehicle that we need. At some convenient point, frequently on top of the generator, the vapors of oil are added. That is where the hydrocarbons are put in. Petroleum, gas oil, crude oil almost in any form that can be vaporized, is simply injected into the apparatus and immediately vaporizes in the intense heat. The oil does not burn for the reason that there is no air for combustion, the vessel being entirely sealed. The oil vapors, the hydrogen, and the carbon monoxide pass over together into the second chamber. The object of this second vessel is to serve as a mixing and fixing chamber for the crude gas. It was found very quickly that if the gas loaded with oil vapors was put out into the distributing system unfixed or in indifferent shape it would be resolved into its constituents, the oil condensing in the mains, leaving very little illuminating power to the gas. It was necessary to devise means to prevent the constituents giving trouble by separation in the later steps of distribution. It was found that the simple process of passing these mixed gases through red hot firebrick made them so fixed that when they left the machine they had practically no tendency to separate. It is of interest to note that the vessel located back of the generator and serving to fix the product without additional expense is fired by the otherwise waste heat resulting from blowing up the generator and getting it hot. The heat from the first vessel is diverted to and heats the second vessel without the addition of a pound of coal to the orginal fuel bill.

Such is the original form of apparatus as made by Professor Lowe. It was found that the single second vessel, or superheater (so called, I think, for the reason that the arrangement of the firebrick was an imitation of, or an appropriation of, the superheater used in the Siemen's furnace in steel works—at any rate, that name became attached to it and has clung to it ever since) was insufficient, and a second one is now inserted between the two original vessels, serving as the connecting link, replacing the goose neck, and practically doubling the capacity of the checker brick and the fixing element of manufacture. The temperature of the brick in the first superheater is much more uniform than the varying temperature of the coal bed. The blast and the introduction of the steam make considerable range in the latter's temperature, and it is desirable to introduce the oil into a temperature fairly uniform as far as possible; so that now, for that reason, the oil is almost invariably put into the middle vessel. One can get a good idea of the water gas process if one will simply conceive for a moment an old iron stove, almost white hot, a stove such as one sometimes sees while belated in a country railroad station. If one of these stoves should be arranged so that it would not leak, and we would simply inject a small amount of steam under the grate, up through the coal or carbon, that steam would turn into pure water gas. If, then, a little oil should be inserted into the stove through the top, crude illuminating water gas would come out of the stack into the chimney.

It is somewhat interesting to bear in mind by us as Philadelphians that the relative perfection of the modern water gas process has been accomplished by the United Gas Improvement Company of this city. Fifteen or more years ago this Company realized that the water gas process was the coming process, and acquired the patents and commenced the construction business. From that time it has steadily filled the country with water gas apparatus, the recognized standard machinery of its class, as standard as the Hoe printing press, the Corliss engine, the Winchester rifle, and any such apparatus predominating in its line. It may further be of interest to know that the original water gas plant was built at Phœnixville, Pa., in 1872, and that by the course of events at this time I happen to be a part owner of that plant, and that the Phœnixville plant has become the starting point of another innovation in the gas business, which, while by no means as radical as the water gas process, is, nevertheless, I believe, going to be a most distinct addition to and innovation in the general production, distribution and economy of gas manufacture.

Whether one makes coal gas or water gas, however, is a matter of local conditions. In either case, after the gas is made the succeeding steps are comparatively uniform and well determined, and almost the same in every gas works in this country.

The distribution of gas for years and years has been, as a whole, upon the basis of an extremely low pressure. It seems strange that gas should be sent out at only $\frac{1}{5}$ of one pound of steam pressure, and yet that is probably the pressure at which the great majority of gas companies deliver their product. Steam is handled on the public streets of some cities at 100, 200 and 300 pounds pressure. Water is distributed at 100 and 200 pounds pressure. Ammonia, oil, compressed air, and a great many fluids are handled in public places, at, for instance, 200 pounds pressure. We sit over a tank of Pintsch gas at 200 pounds pressure in railroad cars and do not have accidents. Every fluid, practically, *excepting* artificial gas, is delivered within a range of many pounds. Natural gas is delivered across country and in streets of cities at several pounds pressure. It is exceedingly strange that tradition and habit, and the fact that our grandfathers did it, have up to this date kept gas distribution at such a really strangely low pressure. It is often being pushed out five and more miles away from the works at but $\frac{1}{2}$ or $\frac{1}{4}$ of 1 pound pressure. Of course, the direct result is the necessity of using large-sized pipes to carry the volume of gas and deliver it. Some little time ago I fell into the train of thought of wondering why one could not distribute artificial gas just as well as natural gas under some pounds pressure, and I finally became well satisfied that there was no reason why one could not use *pressure* instead of *diameter* for getting the product to consumers. The Pintsch people use illuminating gas under pressure, and have done so for many years. Some six months or more ago I was so situated at Phœnixville that I desired to send gas to Royersford and Spring City, five miles above. I figured that it could be done very easily, readily and satisfactorily by pressure, and it resulted in my laying a 3-inch pipe line from Phœnixville to the town named, putting in a compressor and pumping the gas in that fashion. The line was started in October, and

finished December 29th. From that time until now it has been working satisfactorily, with neither trouble nor the suggestion of trouble. It was claimed by skeptical friends that the machinery would break down and that the pressure reducing regulators would not work, and that the candle power in the gas would be reduced; that the illuminants would be precipitated, and the flame would be so impoverished that there would be great loss of light. I felt that, with only a moderate degree of compression there would be practically no loss of candle power at the end of the line, and that as every mine in the country today practically has an air compressor or compressing machinery of the modern type, and of such a nature that it is not liable to be broken down, that there was no risk involved in using that machinery any more than in using a steam engine. The regulating mechanism at the far end of the line is an appropriation of the mechanism used in natural gas distribution by which gas has been sent for many years across the country under pressure, and in which proper and reliable regulators are needed at the terminals and in the houses of the customers. I put in an 8 by 12 inch compressing pump, a 3-inch pipe line, made some few provisions against possible accidents, started the line up, and it has not ceased to operate from that day to this. It is serving a town five miles away from the base, and has been doing it for some months —doing just exactly what has been done with natural gas for years; the system has evinced not the slightest likelihood of trouble, no tendency to break down, and no trouble with the lighting power. I feel that with the successful operation for four months I have practically proved that gas can be compressed, pumped and delivered at a distance under some pounds pressure perfectly satisfactorily. The result is that the investment required in such matters is about one-half to one-third of that otherwise necessary. It enables consolidation and reduction of expenses. It is particularly applicable to new companies which are about to cover scattered districts. Gas companies are not like electrical companies. It costs much more to run a pipe than it does to run a wire. Expense in delivering gas around a large city is very heavy. So satisfied am I that high-pressure gas distribution will continually work, and satisfactorily, that certain associates and myself think of putting in a third line of that nature (we are building a second already in New Jersey), which will have upward of 30 miles of pipe. The gas will be conducted the same as natural gas, to every household. A regulator will be put in every cellar, the high tension cut down, and the gas pass through the ordinary meters. We will use 6-inch pipes instead of 16-inch, and make just that much saving. The only point to be considered is the question of safety. We cannot afford to let high-pressure gas get past the meter in a cellar. With that point covered, however, the mechanism is perfectly satisfactory. That point can be covered by a most simple device—a seal or a return bend of pipe leading into the atmosphere from the basement or cellar filled with oil that will not freeze. If for any reason the regulator goes wrong, or the high pressure gets by the regulator, it blows the oil out of the seal and immediately vents itself into the atmosphere, and does not reach the consumer's premises. Such being the case, it seems to me the last objection is removed to gas under high pressure.

Discussion.

F. W. Gordon—Some four or five years ago the Philadelphia Engineering Works built and erected for the Louisville Gas Company, at the works in the northern end of that city, a compressor 32 inches in diameter and 48-inch stroke, driven by an extended piston-rod of a 20-inch and 48-inch Corliss engine, R. P. M. 60. This compressor was to transfer to a holder in the southern end of the city the gas heretofore manufactured at and distributed from that point. The main was 10 inches internal diameter, 2.2 miles long. The piston displacement of this compressor was about 153,000 cubic feet per hour, and two to three hours' service per day was sufficient for the requirements at the time of this installation, whereas the actual gas delivered was but 143,000 cubic feet, measured by the supplying holder, the loss being accounted for by the inefficiency of the suction main and the compressor. The exact measure of the gas being known, from careful observation of the fall of the holders, the resistance of the 2.2 miles of the 10-inch main connecting the two holders could be accurately determined. That it nearly agreed with observations made in the natural gas fields of Ohio and Indiana, corrected by the specific gravities of each gas, is a valuable datum for future engineering purposes. Taking the initial and terminal pressures and the coefficient of friction observed in the natural gas fields, this 10 inch main, if straight, should have discharged 140,000 cubic feet, whereas it actually did deliver 143,000. The observations in the natural gas field were taken from pipes under various initial and terminal pressures and diameters, and up to 50 miles in length, and that the coefficient of friction applying to such duty should apply to the light duty at Louisville is good confirmation of its correctness. This method of calculating resistance is applicable to the transmission of compressed air under high and low pressures, and for long distances.

W. Forstall—I have not very much to say, but would like to touch on a point or two where Mr. Shelton may have given the impression that there was only one side to the subject. He advocated cement joints as superior to lead ones. Certainly, a line, if well laid with cement joints will be tighter than where lead is used, and as the cement joint is even stronger than the rest of the pipe, any strain on the line is apt to cause a break in the iron itself, and therefore one big leak instead of a number of small ones at the joints, as is usually the case where lead is used. In our Philadelphia practice we are afraid of the consequences that might ensue from the one big leak in the crowded business or residence districts, where the various electrical conduits offer ready means for explosive mixtures of gas and air, and therefore we use lead everywhere except in the suburbs, portions of Manayunk, Germantown and West Philadelphia. Here we prefer cement, because of its cheapness and less liability to leak, and in case of a break the escaping gas soon makes its way to the surface, there being no conduits to spread it underground. We do not, as is sometimes the practice elsewhere, put in an occasional lead joint among the cement ones to allow for expansion. Mr. Shelton has expressed surprise that gas should be distributed at so much less pressure than water or steam. I should say the answer is, that in considering the size of any conduit to be laid under the conditions that now obtain in city streets, if cast iron is taken there is a certain minimum size that must be used because of strength requirements against external strains, without reference to capacity. This size we consider should be 4 inches or even 6 inches, where conditions are very severe. These sizes enable sufficient gas to be distributed for city needs at very low pressure, whereas this is not the case with water or steam. The objections, from our standpoint, to following Mr. Shelton's advice to use wrought iron pipe at high pressure, are that under city conditions, where services are very numerous, the cost of special service connections and of house governors would be more than the amount saved in pipe—on service mains, at least—and that, taking systems of distributing mains as they are at present, the cost of changing over would be out of all proportion to the advantages gained, especially as the life of wrought iron underground is a question of some doubt. Where Mr. Shelton has used wrought iron pipe under high pressure seems a very promising field, and undoubtedly others will follow his lead where similar conditions obtain. When Mr. Shelton is in a position to measure by bar photometers the candle power of his gas before and after compression we shall have exact knowledge of what loss it suffers.

The President—Some months ago the first reference to this new system came to my attention in an article in which the possibilities for improvement by other means were referred to—*e. g.*, the substitution of terra cotta for cast iron pipes, without departing from the present low pressures. I would like to hear Mr. Shelton's views of this scheme.

Mr. Shelton—Without rendering any account of the actual use of terra cotta pipe, I may say that one of the gas associations about a year ago (when the price of cast iron pipe was making our hands go up in the air) suggested the use of a terra cotta pipe with cement joints, as made with cast iron pipe. This would, undoubtedly, be a strong, lasting and cheap gas conductor, but no one as yet has seemed to have the courage to undertake the actual use of it. Terra cotta pipe is very strong, being usually almost an inch thick, and often requires a sledge hammer to crack it; as far as strength is concerned, generally speaking, it would be ample. Personally, I would be inclined to be mistrustful of its spanning strength if long mains of it were exposed—by parallel sewer excavations, for example. I should be inclined to think it would be "brittle," and that having so many joints would give trouble. I would like to comment to a small extent on the thoughts of my good friend, Mr. Forstall. I believe the time will come when high pressure will be used in our most crowded streets, although, of course, I do not expect that to be accepted now. I think Mr. Forstall well reflects the traditions and the reasons why it is not yet so used. The question of making the joints of service connections is not giving the slightest difficulty. The wrought iron pipe is thin, it is true, but by the use of a saddle one gets just as much strength as is wished. Natural gas engineers, of the better class, doing that work use saddles right along, and do not have the slightest uncertainty in making tight service connections. In regard to the use of wrought iron pipes at large, I may say that within a week, on the recent trip that compelled making this an extemporaneous address, and not a carefully written article, the chief engineer of the Pittsburg Consolidated Companies told me he would never

lay another foot of cast iron pipe in the streets of Pittsburg for natural gas. He had laid wrought iron pipes years ago, and to his surprise and gratification they are lasting far better, even in bad ground, in Pittsburg than expected. The pipes have been there now from 10 to 15 years, and have not begun to give out, and are not within reach of doing so. I believe such evidence as that, under such conditions, given by a man qualified to speak, is a very strong indorsement of the use of wrought iron pipe in the manner noted. Of course, installation expense is increased by reason of the regulator necessary to put in the house, but that is only perhaps $3. But by the use of 20 pounds pressure instead of ½ pound or less, one can get from 10 to 15 times the capacity with the present mains, and that increased capacity far overbalances and predominates, in my judgment.

Mr. L. Y. Schermerhorn—How much gas can you send in one hour through a 3-inch pipe under 20 pounds pressure?

Mr. Shelton—At Phœnixville we deliver about 4,000 to 5,000 feet an hour.

Mr. Schermerhorn—What would be the maximum?

Mr. Shelton—One hundred thousand feet per day, with the compressor running at 75 per cent. of its speed.

Francis Schumann—What would the loss be?

Mr. Shelton—Practically none at all. I would like to ask at what pressure the gas in Louisville was delivered, from one end of the town to the other? I have tried very hard to find some precedent for pumping gas at high pressure. I did not know of the Louisville instance.

Mr. Gordon—It started at about 5½ pounds, and was delivered at almost atmospheric pressure, or, rather, ordinary gasholder pressure. They used a piston compressor with double stroke. The compressor cylinder was 32 inches in diameter, 48-inch stroke. It has been used now for 4 years, as far as I know. It is quite a large installation. A Corliss engine, 20 inches in diameter, drove the compressor tandem to it at 60 R. P. M. The purpose was to stop the use of the lower works and concentrate all the manufacturing at the northern works, and deliver gas to the other end for distribution from the Portland holder.

Mr. Shelton—We must have pressure, and it is the very crowded condition of the city streets that will bring us to pressure and enable and compel us to use a 6-inch pipe instead of the 20 inch of to day, that is delivering gas under only the ordinary pressures of $\frac{1}{10}$ of 1 pound to ½ of 1 pound. Nearly every other commercial fluid is being distributed at from 200 to 500 pounds pressure, and wrought iron pipes are used. The fittings last, and the appliances last and are standardized. They are sufficiently developed. It is done with other fluids; it is done with natural gas; why can not it be done with illuminating gas just as well? I cannot get away from thinking that it is chiefly tradition that is keeping illuminating gas companies to-day to this very low pressure—against their own interests when considered from the standpoint of the very heavy investment they are using and think necessary to use. A 6 inch pipe will do the work of a 16 or 20 inch pipe. Gas loses in quality practically nothing by moderate compression, and there are no especial mechanical difficulties. The plan is working perfectly satisfactorily at Phœnixville, and there is not the suggestion of trouble. If it will run 4 months it will run 4 years; if it will run 4 years, it will run 40 years; if from one town to another, it will run from one county to another. I have never been so convinced in any new line of thought as in this, that the results will be exactly in practice what they figure to be in theory.

Mr. Schermerhorn—I note that Mr. Shelton states that under a pressure of 20 pounds per square inch, about 5,000 cubic feet of gas per hour were discharged through the 3-inch pipe referred to. This would be equal to 1.4 cubic feet per second, which, divided by the cross-section of the 3-inch pipe, would give a velocity of gas through the pipe of about 28 feet per second; or at the rate of nearly 20 miles per hour.

Mr. Gordon—What was the terminal pressure of the gas?

Mr. Shelton—Ten per cent. less, with a range of 15 pounds starting pressure; about 2 pounds less pressure at the far end. We had instantaneous communication by telephone at each end of the line. With 20 pounds pressure at the start we get 17 to 18 pounds pressure at the far end. We can tell by the eye the quality of the gas. Upon looking at the same gas at each end one can not tell the difference or observe any loss of illuminating power. It is sufficient for all commercial purposes. Just as many dollars will be taken in the course of a week with the quality at the far end as at the starting point.

Mr. Schermerhorn—Was any special joint used other than the ordinary joint which belongs with wrought iron pipe of that size?

Mr. Shelton—We used what is known as "line pipe," used in the oil country for transporting oil. It has double taper sockets instead of the ordinary, and a rather fine thread. Doubtless some of those present know exactly what it is. It is a little better than the ordinary pipe.

The President—Have not accurate determinations been made as to the loss of candle power at increased pressures? The matter seems to be such an important one that I should think it is well determined.

Mr. Shelton—It may be. I think the Pintsch Companies have quite clearly shown the loss in candle power. Pintsch Companies, operating so many stations for serving railroad cars, usually put in their plants for making oil gas, because they have to have a great amount of illuminant in a very small compass to run cars from 48 to 60 hours. Oil gas, being so rich, is particularly good for that purpose, and is usually used. In addition to that, they have found that oil gas stands compression better than any other gas, but there are places where they have not seen fit to put in their own works, and have used city gas and compressed it; and when they compress city gas to 250 or 300 pounds pressure they find there is a loss of something like 20 to 33⅓ per cent. in candle power. The compression "knocks out" the illuminant in city gas, and until there is no more than ⅓ of the orginal candle power left. Starting with, say, 24 candle gas, we may get perhaps 16 after compression. City gas can not be compressed without heavy loss, and it follows that city gas can not be compressed to 200 pounds per inch or more; but my thought was that compressing it to only $\frac{1}{10}$ of that (that is, from 10 to 20 pounds instead of 300) the practical loss in candle power would be only 1 candle, or ½ a candle, or not serious; and the result of my work so far bears out that idea; other evidence indicates that compression up to 50 or 60 pounds makes no special difference. It enables us to reach a range far beyond the present range of pressures used with artificial gas without serious loss in candle power.

The Design of Steam Plants.--No. II.[1]

[By Mr. Henry C. Meyer, Jr., in *Engineering Record.*]

Heating Surface Necessary.—The function of a steam boiler is to transmit to the water it contains as much of the heat generated by the combustion of fuel as possible. Each square foot of heating surface in the boiler can transmit only a certain amount of heat when the highest economy is being realized. By increasing the supply of heat a greater amount is transmitted, and consequently a greater amount of water is evaporated by each square foot of heating surface, but with the increase, the same percentage of the heat generated is not utilized. The reason is that after a certain rate of evaporation is reached, the maximum capacity of the metal in the boiler plates to transmit the heat is more nearly reached, and hence a larger percentage of the heat of the fuel passes up the chimney. In other words, it is possible to evaporate a certain amount, say three pounds, of water per square foot of heating surface in a given time and to utilize a certain percentage, say 80 per cent., of the heat in the fuel, 20 per cent. going to waste. It is also possible to burn more coal and evaporate say five pounds of water per square foot of heating surface in the same time, but when doing so a greater percentage, say 30 per cent., of the heat of the fuel is lost. The selection of the proper amount of heating surface for a steam boiler is, therefore, a very important matter.

The best efficiency, under ordinary working conditions, with most boilers, is obtained when evaporating about three pounds of water per square foot of heating surface per hour, from a feed temperature of 212° F. into steam at atmospheric pressure. This is equivalent to allowing nearly 12 square feet of heating surface per boiler horse power. Some water tube boilers with certain coals seem to give a good result when the heating surface per horse power is a little less than that stated. Most boilers, sometimes, and quite frequently in fact, attain a high efficiency when the rate of evaporation is considerably higher than that given. Such high results with most boilers are usually attained, however, when all of the many conditions affecting the efficiency are such as to produce a good result. Many of these conditions are not so favorable when a boiler is operated in ordinary service. For instance, if the boiler surfaces are not clean, owing perhaps to the accumulation of scale or soot, the efficiency of the heating surface will be more or less impaired. For this and other reasons, the writer believes it is well to provide ample heating surface for the work to be done, for not only will such a course result in a saving of fuel at ordinary rates of evaporation, but it will make it possible to run a boiler considerably above its rating and still maintain a fair efficiency.

Value of a Boiler Horse Power.—According to the American Society of Mechanical Engineers' standard, a boiler to develop one horse power must raise 30 pounds of water from a temperature of 100°

1. *Ante*, p. 5.

F. to the temperature of steam at 70 pounds pressure, and evaporate it into steam at that pressure. This is equivalent to evaporating 34½ pounds of water at a temperature of 212° into steam at atmospheric pressure, or "from and at 212°," as it is sometimes called. The term horse power is frequently used when estimating the capacity of steam boilers, and the custom of buyers was formerly to ask for boilers of a certain horse power. This is an improper way to buy boilers unless the amount of heating surface per horse power is closely examined. If bids are called for boilers of a given horse power one bidder might offer a boiler with ample heating surface, while another might offer a boiler with much less. Both might develop the required horse power, but the one with deficient heating surface might do it only at an increased cost for fuel, as explained in a previous paragraph. In saying this it should be borne in mind that the efficiency of various classes of surfaces varies according to their location and arrangement, but this variation in first-class boilers is confined to narrow limits which can only be detected by the expert.

Advantages of Types of Boilers.—Barrus, in his excellent work on "Boiler Tests," states "that the economy with which different types of boilers operate depends more upon their proportions and the conditions under which they work, than upon their types; and, moreover, that when these proportions are suitably carried out and when the conditions are favorable, the different types of boilers give substantially the same result." So much for the side of efficiency. As to safety, the water-tube boiler is, of course, far superior to boilers of the fire-tube type. In fact, water-tube boilers seldom explode, although the tubes sometimes burst and injure those firing them. Water-tube boilers also possess an advantage in that they contain less water than the shell type, as usually designed, and consequently steam can be raised in them more quickly. More water can probably be evaporated per square foot of heating surface in a water-tube boiler than in one having fire tubes, on account of a larger passage for the gases, and possibly on account of a better circulation of water in contact with the heating surfaces. The efficiency of the two types is about the same, the difference depending more upon the proportions and management, as Mr. Barrus states, than upon the types. Water tube boilers have increased in favor very rapidly in the past few years, particularly for electric work, where large amounts of steam are wanted suddenly, and sometimes without previous warning. In spite of the fact that the water tube boiler possesses advantages over it, the fire tube boiler, particularly the horizontal return tubular boiler, is still used to a very considerable extent on account of its lower cost. An internally-fired boiler, such as the Manning, locomotive, Galloway or Lancashire boiler, all of which are of the fire-tube type, possesses advantages over the brick set boilers in that there is not the air leakage into the furnaces, reducing the efficiency that is often found in the boilers which require a brick setting. Furthermore, they do not need the costly brickwork. Internally-fired boilers are, on the other hand, unless provided with large furnaces, very poorly adapted for burning bituminous coals, which require very large combustion chambers, so that the flame from the burning coal cannot come in contact with the relatively cooler surfaces of the boiler and thus become cooled to such an extent that combustion ceases and the gases pass to the chimney unconsumed and consequently wasted. For this same reason, horizontal tubular boilers must be raised a good deal higher above the grate if bituminous coal is to be burned than if anthracite is used. It is held by some engineers that bituminous coal gives the best results if it is burned in a furnace entirely separate from the boilers, so that the radiant heat from the fires will heat the firebrick lining, or checkerwork, that is sometimes introduced in the combustion chamber, to such an extent that the gases coming in contact with this highly heated brickwork are consumed before reaching the boiler. Horizontal return tubular boilers are seldom used for pressures as high as 150 pounds.

Division of Heating Surface in Units.—The first problem connected with the design of a boiler plant is to determine accurately the maximum number of pounds of steam that will be used by the various engines, pumps, and other parts of the plant which will have to be supplied. The condensation in steam pipes should not be neglected. As has been said, one square foot of heating surface should be allowed in most boilers for every three pounds of water to be evaporated into steam from and at 212° in an hour's time. With this proportion and sufficient draft and grate surface to burn the necessary amount of fuel, a boiler can easily be forced 33⅓ per cent. over this capacity and maintain a good efficiency. It ought to be stated here, however, that the maximum evaporation of a boiler is limited by the amount of coal which can be burned upon the grate. If the draft is sufficient a good boiler can develop a horse power upon one-third of the surface recommended. By dividing the total number of pounds of steam that are to be evaporated from and at 212° per hour by 3, the amount of heating surface may be obtained with sufficient accuracy.

The next step is the subdivision of this heating surface into the proper number of boilers. This is of considerable importance, for careful study may result in much saving in the first cost and in the cost of operation. For instance, if boiler capacity equivalent to evaporating 28,800 pounds of water from and at 212° an hour is required, 9,600 square feet of heating surface will be needed. As each square foot of heating surface may be overloaded 33⅓ per cent., it is evident that if the 9,600 square feet were divided among four boilers one boiler might be shut down for repairs or cleaning, which is frequently necessary, and the other three run at 33⅓ per cent. overload and still give 28,800 pounds of water per hour. If the total heating surface was divided into three boilers, each of 3,200 square feet of heating surface, two might not be able to run the plant alone, so a fourth or spare boiler would have to be supplied. This would manifestly be a poor division of power, as the money spent on the spare boiler would represent so much capital lying idle most of the time. The frequency with which a boiler is shut down for repairs or cleaning depends upon the attention given it and the character of the feed water.

Importance of Proper Grade Surfaces.—To evaporate a given amount of water into steam it is necessary to generate a certain amount of heat by the combustion of fuel. The factors controlling the amount of heat generated are, the kind of coal, the amount of grate surface the boiler contains, and the draft. The draft affects the rate of combustion, as the amount of coal burned on each square foot of grate surface in an hour's time is usually called. Of the factors mentioned, that pertaining to the kind of coal to be used should be determined by an engineer before designing a boiler plant. He should investigate the cost of the various fuels available at the locality at which the boiler plant is to be constructed, and with these data and a knowledge of the relative evaporative power of the different fuels, the engineer can determine in advance by calculation the cheapest kind of coal and construct the boilers so that it can be used. Many plants have been somewhat handicapped by the failure of their designer to consider this subject. Some coals, besides having less heating power per pound than others, cannot be burned at as high a rate of combustion on account of peculiar properties they possess. For instance, with the finer sizes of anthracite coal, it is impossible, unless mechanical draft is used, to burn more than a limited amount on a grate, as the particles pack together so closely that the air cannot get through the bed of fuel in sufficient quantity to permit a rapid combustion. Of course, if only a limited amount of fuel can be burned on a grate, the grate has to be made large in proportion to the heating surface, and when it is intended to burn a low grade fuel, provision for a large grate ought to be made in the first place. If a plant is designed to burn a low grade fuel, and it is desired to change to a fuel of better grade, this can be done by reducing the size of the grate by bricking off a portion of it. With a better fuel less coal would be burned, and consequently so large a grate would not be needed. It might seem that it would not be necessary to reduce the size of the grate to burn less fuel, but, although less fuel could be burned per square foot of grate by reducing the draft, yet it would probably not be good practice to do so, as it is necessary to burn a coal at a fairly high rate of combustion to secure the best result. Too low combustion results in the partial burning of the gases, and this causes a loss. If it is certain, before a plant is constructed, that there never will be a desire to operate it with a lower grade of fuel than that for which it is designed, it would be foolish to provide larger grates than are necessary for this fuel, as boilers so constructed are frequently more expensive both in cost of construction and land occupied. A high rate of combustion is undoubtedly the best for all coals for the reason that the gases are much more thoroughly consumed when the furnace temperature is high.

Proportioning Grate.—The ratio of the grate to heating surface varies with the kind of coal and the amount burned, as was explained in an earlier paragraph. From a knowledge of the number of pounds of water to be evaporated, and the amount one pound of a given kind of coal will evaporate under ordinary conditions, the quantity of coal which must be burned in a given time can be calculated. If one knows the number of pounds of coal that must be burned, and the amount of coal that should be burned on each square foot of grate surface, in a given time, the amount of grate surface can be determined.

It remains, then, to provide sufficient draft, either by a fan or chimney, to produce not only the proper rate of combustion for ordinary demands, but also a higher one which will enable the boiler to operate

with such overload as may be thought necessary. The relative evaporative power of the better grades of a number of different coals is shown in the table, Pocahontas coal being placed at 100. These figures are approximate and should be used with some caution. The relative evaporation for the different coals shows what might be expected from the better grades of each kind of coal mentioned when fired by a good fireman under ordinary everyday conditions. The variations from these figures which might result from a difference in the quality of the coal from the same mine would be greatest with the Western coals, less with the Pennsylvania bituminous, and least with the semi-bituminous group. The anthracite, particularly the small sizes, might vary considerably on account of an abnormal amount of impurities present in the coal. The figures given in the table can be exceeded somewhat when all the conditions are favorable.

Relative Value of Steam Coals.

Kind of Coal.	Relative Evaporative Power.	Pounds of Water that One Pound of Coal will Evaporate into Steam at 212° Fahr., under ordinary conditions.	Pounds of Coal per Square Foot of Grate per Hour.	Ratio of Heating to Grate Surface.
Pocahontas, W. Va.*.....	100	9.5	15	45
Youghiogheny, Pa.†.....	90	8.5	17	48
Hocking Valley, O.†.....	80	7.6	18	45
Big Muddy, Ill.†.....	80	7.6	22	55
Mt. Olive, Ill.†.....	67.5	6.4	22	45
Lackawanna, Pa.,‡ broken.	87	8.5	15	35
Lackawanna, Pa.,‡ No. 1 buckwheat.....	73	7.5	13	32
Lackawanna, Pa.,‡ rice....	63	7.0	13	30

* Semi-bituminous. † Bituminous. ‡ Anthracite.

The table also shows about the amount of coal which should be burned per square foot of grate per hour under ordinary conditions; also, the ratio of heating to grate surface necessary for the boiler to develop its rated capacity when burning about the amount of coal stated and when each pound of coal is evaporating the quantities of water given in the table. It is proposed to provide sufficient draft, that equivalent to the pressure of 0.5 inch of water, to run easily a boiler proportioned according to the data given in the table at one-third over its rating. Five-tenths of an inch of draft will hardly be sufficient with the rice size of anthracite, or perhaps the Mount Olive or similar Southern Illinois coals, to enable a boiler proportioned according to the data in the table to operate with an overload of one-third. With the rice size of anthracite mechanical draft ought to be used, in which event a smaller grate can be provided than that recommended in the table. It is well to have a maximum draft of 0.6 inch of water available for the poorer Illinois coals.

It is undoubtedly true that a better result will be obtained by higher rates of combustion than those given in the table, but if these are increased for the normal working of a boiler it will be necessary to have available a very intense draft, nothing less perhaps than that created by a fan, in order that there may be sufficient reserve draft to operate the boiler at much of an overload. In other words, if the rates of combustion are assumed to be higher than those given for ordinary service, the draft must be made correspondingly greater to provide a reserve capacity in evaporative power. The high rates of combustion possible with mechanical draft are conducive to high furnace efficiency, but that is a subject that will be discussed later.

Coal.—In an earlier paragraph attention was called to the necessity of proportioning boilers to burn the fuel which will be the cheapest. It seems well, therefore, to show in a general way some of the properties and the relative values of different steam coals. Such information can be misleading on account of the variations that exist not only in different coals, but in coal mined from the same seam. Nevertheless an approximate relation can be given for the better grades of several different coals that are typical of the kinds most used. What the poorer grades of coal of some of these kinds will do, it is impossible to predict. The steam coals used in the eastern and middle parts of the United States may be divided into anthracite, bituminous and semi-bituminous classes. A coal is classified in these groups according to the relative proportions of fixed carbon and volatile hydrocarbons that it contains. The hydrocarbons are those gases given off by certain coals when they are heated moderately. Semi-bituminous coals contain less than 25 per cent. hydrocarbons and bituminous coals 25 to 60 per cent. The former are the best steam coals for the reason that when the hydrocarbons are more than 20 per cent. of the fuel composition, the heat value of the fuel becomes less, for then the hydrocarbons contain more or less oxygen while with less than 20 per cent. hydrocarbon, the volatile gases are mostly hydrogen and the coal therefore has a higher heat value. The percentage of hydrocarbons in anthracite coal is very small.

Semi-Bituminous Coals.—This group contains the finest steam coals mined in the United States. They are found mainly in Virginia, West Virginia and Maryland. The ash varies from 3 to 8 per cent., while the coals contain about 14,500 heat units per pound. The coals of this group are much more uniform in heating power and evaporation than those of any other, but there is a variation in some of them owing to the fact that care is not taken to exclude impurities which affect their heat value. This group of coals includes the Pocahontas, New River, Cumberland (George's Creek), and Clearfield varieties. The value is about in the order named, Pocahontas and New River probably being the most constant in quality. Placing the evaporative power of Pocahontas and New River at 100, none of the other coals would be hardly less than 95.

Bituminous Coals.—These are found in Pennsylvania, Ohio, Kentucky, Tennessee, Indiana, Illinois, Missouri and other States. They differ widely in heating power, not only one coal from another, but a great difference is also found in coal from the same mine. The bituminous coals are divided into two classes, caking and non caking. The Indiana, Illinois and Missouri coals are of the caking variety, which on burning becomes pasty and forms into lumps that greatly impede the fire unless broken up. The western coals have to be burned at a comparatively high rate of combustion, about 20 pounds of coal per square foot of grate per hour, otherwise it is difficult to keep the fire from going out. The Pennsylvania coals are much the best for steam purposes, and the Ohio coals are usually better than those found farther west.

Anthracite Coal.—This is mined chiefly in Pennsylvania, although quite a little is found in the far West. It is principally composed of pure carbon and its heat value is dependent mainly on the amount of earthy matter mixed with it when sold. The percentage of earthy matter is naturally greater in the smaller sizes. Anthracite coal is classified according to size into lump, broken, egg, stove, chestnut, pea, numbers 1 and 2 buckwheat, rice and barley. Pea coal is about as large as is usually used for steam purposes. The larger sizes of this coal, that is, the chestnut size and over, are about equivalent in evaporating power to Pittsburg bituminous coal. The smaller sizes require a very strong draft because the particles of coal, being small, pack together so that the air cannot get through the bed of fuel to cause rapid combustion. It is therefore impossible with natural draft to burn more than a very limited amount per square foot of grate, and it is inconvenient and costly to provide boilers with a sufficient grate to burn buckwheat or the smaller sizes with the draft due to an ordinary chimney. It is necessary, therefore, if this grade of fuel is to be used to construct a 125 foot, preferably a 150 foot chimney, or to employ mechanical draft. Rice and the smaller sizes can hardly be burned without mechanical draft. With 0.5 inch of draft from 16 to 18 pounds of good clean buckwheat coal can be burned per square foot of grate per hour.

An Improved Door for Laboratory Gas Furnace.

By Mr. B. A. Burrell, F.I.C., Leeds, England.

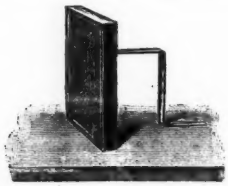
The existing forms of doors for reverberatory gas furnaces are made of fire clay or other refractory material, and have no outer casing; they are, therefore, easily broken, and not suited to withstand the rough usage they often receive from students.

Careless handling with the tongs soon causes the front projection to crumble away, and when this occurs they are awkward to move, and soon acquire a tendency to lean away from the furnace, leaving a gap between the furnace and the door, with consequent loss of heat. Further, all the existing forms of door, except Holloway's pattern, will not stand upright when removed from the furnace.

To overcome these objections I have devised the door shown in the accompanying cut.

These doors have an outer casing of thin wrought iron, except at the front, which is exposed to the interior of the furnace. At the front the outer casing only projects slightly round the four edges.

The bottom edge of the door is set at such an angle as to give the door a very slight backward tilt, but it is prevented from falling by the piece of bent hoop iron inserted in a slot fixed on the back of the door; the door will thus stand upright when withdrawn from the furnace, and the hoop iron serves as a handle. (A piece of asbestos cloth should be used as a holder).



The two side edges of the casing are inclined at a slight angle from front to back, so that the front is slightly narrower than the back. Better fitting is thus obtained, and the lining of fire clay prevented from falling out.

The back of the iron casing is perforated with a number of small holes to permit of the more ready drying of the fire clay mixture with which the door is lined. A suitable mixture for this purpose is composed of two-thirds raw fire clay and one third burnt fire clay (by measure). A little sodium silicate added to the clay paste is advantageous.

The new door possesses the following advantages:

1. It is practically indestructible, since the fire clay lining may be replaced at a merely nominal cost.
2. It can be adjusted so that it has no tendency to lean away from the furnace.
3. It stands upright when removed from the furnace.
4. It is cheaper than the furnace doors at present on the market.

An extended trial in this laboratory has resulted in the replacing of the plain fire clay doors by the iron bound doors, and the consequent abolition of a serious item of expense caused by frequent breakages.

[Concluded from page 92.]

Electrical Measuring Instruments.

[A paper read by Mr. J. Franklin Stevens at a meeting of the electrical section of the Franklin Institute.]

Instruments based on the principle of the D'Arsonval galvanometer are very extensively used to-day for both switchboard and portable instruments on direct current circuits; they can be calibrated so as to show an equally divided scale, and, if properly constructed, are an extremely efficient instrument. Further, they are very well adapted to the measurement of resistances and grounds. In the construction of this type of instrument the important factor is the permanency of the permanent magnet fields employed. It is essential, in the first place, that the proper grade and quality of steel shall be employed, which means a steel possessing high permeability and a high degree of retentivity; then this steel must be carefully worked within definite limiting temperatures and must be treated with great care and skill in the processes of magnetizing and ageing. Further than this, the moving coil should be extremely light and the whole system carefully shielded from the influence of external fields, and yet so shielded that the moving coil will not be robbed of an appreciable number of lines of force, due to the presence of the shielding iron. The greatest field for this type of instrument is in the measurement of heavy currents; that is, for currents of 1,000 amperes and upwards, due to the fact that it can be operated as a shunt instrument, requiring an extremely small drop of potential, full scale being obtained with a drop of from .03 to .05 volt. This means a relatively high efficiency, and, while the instrument does not possess all of the advantages of a series ammeter, yet it is far easier to install, and, where a high degree of accuracy in current indications is not demanded, will be found very satisfactory in practice.

Further than this, the D'Arsonval instrument, which gives deflections directly proportionate to the current flow, lends itself readily to a large variety of measurements, such as determining resistances and measuring the drop of potential from which resistances and grounds may be readily computed. It is, however, a type of instrument which should be handled with great care, as rough handling or the presence of powerful external fields will permanently destroy the accuracy of its indications. Further, since it depends primarily for its continued accuracy on the maintenance of a field of uniform strength, as supplied by its permanent magnet field, instruments of this type should be frequently checked to ascertain whether the permanent magnets have maintained their initial strength.

A great deal might be said on the subject of the last type under consideration, namely, the electro-magnetic system, for there are probably more variations in practical construction contained in this type than in all the other types put together; some are good; many very bad. It is, however, unfair to adopt the policy of certain engineers, who unqualifiedly condemn every electro magnetic instrument, solely and entirely on the grounds that they contain a moving mass of iron, which, in their opinion, must render the instrument subject to errors of lag and hysterisis. My practical experience with this type of instrument, covering a great many years, has taught me that it is perfectly possible to so construct an electro-magnetic instrument containing a mass of moving iron that errors of lag and hysteresis, if they are present, are so small as to be negligible. In order to achieve this result it is necessary, first, to proportion every part of the instrument with reference to all other parts; to carefully shield the instrument from the influence of external fields, and this by means of a shield that will not introduce errors due to its own retentivity. The iron employed should be very small and very light, and should be selected, after careful test, for purity and absence of retentivity. It should then be formed up with care, and so treated that oxidation is practically impossible. The field due to the actuating solenoid should likewise be carefully studied, and should be designed so that the moving iron will at no time be completely saturated, and yet of sufficient strength, in conjunction with the shield employed, as not to permit the indications of the instrument to be seriously influenced by external fields. In no case should two masses of iron be employed, as is common in some types of instrument, which depend on the repulsion of a moving vane by a fixed vane of similar polarity, both being energized by the actuating solenoid. It is almost impossible to free double vane instruments from errors of lag or hysteresis, and there is a further tendency for the pointer to stand off zero, due to the residual magnetism mutually induced in the two vanes.

The fact that the instruments constructed on the electro-magnetic principle contain no material subject to change or deterioration, coupled with the fact that they can be built solidly and substantially, and controlled by gravity in place of a spring or springs, renders them exceedingly reliable in practice. If their calibration is correct when first installed, there is no reason why the calibration should change with time.

In the above brief description of the most common types of indicating instruments, it may be noted that there is no one type which is universal, that is adopted for both switchboard and portable use for either direct or alternating current measurements. While we can very readily dispense with the hot wire and electrostatic instruments, the other four types are essential for some class of measurement, and for any particular line of measurement the most suitable system should be selected. It is possible that some day a universal system may be found, but, until that time, the user must select from existing types the one which in principle seems most applicable, not only to the character of electrical energy to be measured, but also to the conditions under which measurement must be made.

There is no one line connected with the electrical industry in which so much attention must be paid to details as in the manufacture of electrical indicating instruments. A very prominent engineer remarked to me recently that he had examined the construction and operation of a great many different types of indicating instruments, and, while a number of them bore evidence of similarity in design and construction, yet, in some cases, the manufacturer seemed to have acquired the "trick" of proportioning, manufacturing and calibrating, while others utterly lacked the "trick." As a matter of fact, it is not altogether a case of acquiring the proper "trick," but is a case of studying the theory and design of instruments for a number of years, backed by a large and varied experimental experience, which marks to day the difference between the successful and unsuccessful instruments in the various types commercially exploited. Account must be taken of the most petty details of construction, the most careful and skilled labor must be employed in each department, and every particle of material entering into the instrument must be carefully selected and tested with reference to its particular function.

Personally, I have seen the experiment tried of taking a finished and efficient instrument and placing it in the hands of a careful and skilled mechanic for duplication; every wire and every part would be, apparently, an absolute copy of the original, and yet the results obtained would be totally different. It follows, therefore, that it is always wise in placing orders for electrical intruments to select a house who have publicly demonstrated the fact that they have learned the necessary "trick" or "tricks" of their profession.

In no line does reputation count for more than in the manufacture of indicating instruments, nor is there any line in which I have been

brought in contact where it takes so long a time to establish a reputation. Further than this, there is no line in which a greater amount of patience is required by the manufacturer. The average purchaser is totally ignorant of the laws or principles embodied in the instrument he is using, and, without regard to the fact that he may have selected the wrong type for the particular class of measurement he wishes to make, unhesitatingly blames the manufacturer for not having known what he wanted and for not having supplied him with the proper type of instrument by pure intuition.

Another obstacle which is commonly met by instrument manufacturers is the fact that for the average installation he is required to furnish instruments delivered to the switchboard contractor, who may or may not handle the instrument properly. It is true that most instruments are sealed, yet it is perfectly possible to utterly ruin the calibration of almost any type of instrument by improper handling without destroying the seal or opening the case. For instance, if a D'Arsonval instrument is laid upon the frame of an actively excited dynamo or motor, its entire calibration will be almost instantly changed, and yet no external evidence is presented to show exactly what has happened. Rough handling and an occasional fall, or improper packing for delivery to the plant, may further operate to destroy the accuracy of the calibrated instrument; yet the manufacturer is expected to provide instruments which will stand such usage and which, after they have been installed, may be subject to the influence of such strong external fields or such high external temperature as to make their correct indications impossible; and, after all of this, must have his instruments accepted or rejected by the consulting or supervising engineer, who, on the day of the test, carefully checks them with his personal portable instruments, which are usually kept in almost ideal condition and seldom or never leave his immediate possession. Some day I trust these conditions may be modified to the extent that the engineer in charge will test and check the instruments, if he doubts the accuracy of the maker's calibration, before the instruments are shipped; or else issue instructions that the switchboard shall be drilled from template and the instruments set in place by the engineer's own assistants. In several cases I have succeeded in having the latter course adopted, with the result of mutual satisfaction on part of the owner, engineer and ourselves.

If arrangements could be made to have all instruments installed under the supervision of the engineer in charge, it would then be quite sufficient to have the specifications state the limit of error allowed in the indications of the voltmeters and ammeters; and this information, coupled with a specification covering the style of case, character of scale, range and class of measurement to be made, would enable the manufacturer to make an intelligent tender for the instruments required in any installation.

While a high degree of accuracy is desirable in all indicating instruments, it is particularly important that the voltmeter should be right within at least 1 per cent., since a variation of 1 per cent. in voltage means a corresponding variation in the candle power of every incandescent lamp which may be in circuit. It is quite well known that the candle power of any incandescent lamp varies directly with the voltage, the variation being approximately 1-candle power for every volt increase or decrease from the normal voltage of the system.

Further than this, a variation of 1 per cent. from normal voltage on a system carrying incandescent lamps means a variation of about 16 per cent. in the life factor of the lamp and about 3 per cent. in the watt consumption per candle power. Errors in the indications of ammeters do not produce such serious results, yet it is desirable that they should be accurate in order to obviate the danger of overload on circuit, translating device, or generator; and in the case of test instruments, as high a degree of accuracy should be demanded as is required in the voltmeter.

While on the subject of accuracy of indications, I would like to impress upon you the fact that, while we have three electrical units in common use, namely, the volt, ohm and ampere, the ohm and ampere are the only two fundamental units, the volt being a derived unit The absolute ohm may be quite readily obtained, and, as you probably know, is defined by law as the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14.4521 grams in mass, of a constant cross-sectional area, and of the length of 106.3 centimeters. The ampere is likewise defined by law as the practical equivalent of the unvarying current, which, when passed through a solution of nitrate of silver in water in accordance with standard specifications, deposits silver at the rate of .000118 gram per second. The volt is defined as the electro-motive force necessary to send 1 ampere through 1 ohm. This, as you will note, gives us fundamental values for the ohm and ampere and defines the volt as a derived unit, and I am laying stress on the matter for the reason that the average electrical writer defines the volt as a fundamental unit equivalent to $\frac{1}{1434}$ of the potential at the terminals of a standard Clark cell, and then defines the ampere as that current which 1 volt will cause to flow through a resistance of 1 ohm. As a matter of fact, the Clark cell is a secondary standard, exceedingly useful in practice, but not designed for use as a fundamental standard, due to the fact that Clark cells will vary among themselves and will give a gradually decreasing voltage at their terminals after they have been in service any length of time. It is, further, impossible to take 1 ampere from a single Clark cell without permanently ruining it; and, as a matter of fact, the potential of a Clark cell is only correct when the cell is used on open circuit.

It has been rather difficult for me to understand why the absolute ampere has been so little used or so seldom referred to, when it is a unit more readily verified than is possible with the volt. It is true that the fundamental method of determining the ampere is rather slow and tedious, but it is extremely easy to obtain the absolute ampere in c. g. s. units by the use of the tangent galvanometer. Defined in c. g. s. units, the ampere is such a current that, passed through a conducting wire bent into a circle of the radius of 1 centimeter, will attract a unit magnetic pole held at its center with a force of one dyne; and this method applied to the tangent galvanometer gives the very simple formula of current equals galvanometer constant into the tangent of the angle of deflection of the polarized needle, the galvanometer constant being readily determined from its dimensions and the number of turns of wire, in connection with a determination of the value of the horizontal component of the earth's magnetism. Having once determined the absolute c. g. s. value of the ampere, we know that the practical ampere is $\frac{1}{10}$ the value of the c. g. s. unit. Having obtained the absolute standards of current, expressed in amperes, and resistance, expressed in ohms, the standard volt is readily determined from the relations given in Ohm's law. With the primary units once determined, all others, such as the farad or coulomb, can be readily obtained.

To obtain absolutely correct standards of voltage and current for alternating current calibration, it is only necessary to calibrate a dynamometer voltmeter and a dynamometer ammeter in true volts and amperes, as determined by fundamental standards; then, as a dynamometer measures directly the square root of the mean square, it will indicate correctly the virtual voltage or current in an alternating circuit. In calculating resistance in alternating current instruments, it is necessary to modify Ohm's law to the extent of substituting impedance for resistance. Since impedance is the vector sum of the ohmic and inductive resistances, it is readily obtained by triangulation when the two resistances are known, or when one is known and the angle of lag can be ascertained.

While the design, workmanship and material entering into the construction of an instrument are of vital and fundamental importance, the actual calibration is equally important. Assuming the manufacturer has reliable standards of voltage, current and resistance, trained observers are necessary who should be instructed not only to properly mark the scale, but to check it; and should also be instructed to carefully test the instrument for errors due to reversal, to lag or hysteresis, and for errors introduced by the presence of external fields, or by the variations of internal or external temperature. Certain definite limits must be set for errors allowed, and no instrument permitted to go out until it has fully come up to the standard so set. In the company with which I am associated, we not only make all of these tests and check readings, but, likewise, provide an additional check on the calibration by plotting the calibration curve at the time the scale is made by the draughtsman, and if errors or irregularities are observed in the curve showing a departure from the standard curve applicable to the type of instrument under construction, the instrument is promptly returned to the calibrating room to have its readings checked, or to hunt for and remove the defect which caused the irregularity. It is a known fact that for every type of system there is a characteristic scale, following a more or less complex law, and any variation of the calibration from the normal indicates immediately that there is something wrong, either in the construction of the instrument or of some of the elements entering into it; or else it was inaccurately calibrated. I, personally, attribute a great deal of our commercial success to this intermediate checking in the drawing room, and you can put it down as a settled fact that any manufacturer who produces instruments of any particular type the scales of which for corresponding ranges vary greatly from one another has not yet mastered the proper design or construction of his instrument.

It would be impossible to detail the many different kinds of measurements which can be made with the proper type of voltmeter, ammeter and wattmeter. In general, however, the possession of these three instruments enables one to measure not only voltage, current and power, but, likewise, capacity, inductance and resistance; and from these various measurements may be obtained data covering the performances of almost any type of generating or translating device.

There are many special forms of indicating instruments designed to indicate directly some of the various measurements most frequently employed, two of which, at least, are so universally used at the present time that they deserve, at least, passing mention. One is a voltmeter designed for use on constant current arc light circuits, capable of indicating directly the total electro-motive force of the dynamo, and so connected by means of self-contained switches that not only can the total voltage of the dynamo or circuit be read, but, likewise, the presence of a ground indicated and its actual value in volts directly determined. This involves an arrangement of connections so that the voltmeter can be connected directly across the terminals of the circuit and then connected successively from the plus and minus side of line to ground. From the three readings thus obtained the number of lamps burning can be directly ascertained, the presence of the ground shown and the ground itself can be absolutely located by a very simple calculation. By employing, in addition to this, the known resistance of the instrument, the actual resistance of the ground in ohms may be obtained, thus defining its character.

An instrument of this character was brought out by my company some few years ago, and has met with almost universal favor, due largely to the growing tendency to measure resistances under full working potential. Such an instrument will show grounds which would not be shown by the ordinary galvanometer and bridge method of testing, and further enables the switchboard attendant to locate grounds while the line is in operative condition.

Another instrument which, for a time, fell into disuse, but which today is being used more extensively than ever, is the differential voltmeter, designed primarily to show the difference in potential between the bus bars and any dynamo which has to be connected to the bus bars in parallel with dynamos already operating. It is rather a curious fact that the average dynamo tender places implicit confidence in the indications of his differential voltmeter. The mere fact that he can see the pointer come back to zero when the free dynamo is being brought up to voltage, and the knowledge that when the pointer does stand at zero he can throw the free dynamo into circuit without danger of trouble, impresses him with the idea that the instrument is essentially reliable and accurate, and he is already to condemn any or all of his regular switchboard voltmeters which fail to agree with it in indication. This tendency has led my company to devote special attention to the calibration of differential voltmeters and to furnish them with a full scale which indicates the exact voltage of the bus bars, in place of furnishing instruments which give full scale deflections for 10 per cent. or 20 per cent. of the normal voltage.

In closing, I would say that I know of no subject connected with electrical engineering which promises such rich rewards for investigation as the subject of electrical measuring instruments, and if my hasty and very general review of the subject will influence any one to pursue the subject thoroughly and scientifically, I shall feel more than repaid. I have confined practically my entire time and attention to this line for a number of years and find the subject grows more interesting the further I investigate it, and I hope the time is not far distant when the literature on this subject will be as complete and as comprehensive as that now available in allied branches of electrical engineering.

Some Experiences with Municipal Plants.

Prof. G. D. Shepardson, in a paper on municipal ownership, read at the recent convention of the Northwestern Electrical Association, recited some incidents illustrating the incompetent management of some municipal plants. The state of the records kept in some of them is, he said, almost incredible. In several towns there is no complete record of the service connections to the water works and electric plants. In one place, a new superintendent found it necessary to shut off the water to enforce the payment of back water rents. There was no plan of the water mains or services. He, therefore, was compelled to open the streets and search for the cut offs, for which purpose the services of a chain gang from the county jail was secured. In another town, when the collector was getting a promise of payment from a merchant, he was requested to bring in the bill for the meter in the barn at the same time. The collector held his own council, and discovered a meter with a number of lights, for which no record could be found. In that town, the only account books found were an electric light book with monthly columns for accounts of customers, and an individual account book for water consumers, there being no record of purchases, repairs or any other expenses. In another place by a careful canvass of the town and an examination of the lines, water and lights were added to the record of about $900 income per year, and no one knew how long they had been getting free service. In another place, where the rates are low and the water power leaks badly, so that it is necessary to spend several thousand dollars at once, the superintendent is confident that the plant is clearing about $800 net profits per month. In another town "there are no records and no system of accounts."

Closely allied to poor systems of bookkeeping is the incompetency of the city clerk or collector who has charge of records and collections. They do not understand the business, and naturally do not make it pay. In one instance the collector knew practically nothing of the station working, was ignorant of the station output, amount of coal used for electric part of plant, etc. Owing to inefficient and incompetent officers, all sorts of prices were charged for supplies and work furnished the city. For example, a plumber was paid $2.20 for a common valve costing 90 cents, and other items in proportion. In another place, the innocent recorder was beguiled into paying a higher price for a new lot of incandescent lamps, "because they had more watts than the kind formerly used."

The committees of the town councils are often green hands and of little value in administering municipal plants. In one place a former collector had been found short in his accounts, and a committee was appointed to check his work. After two days upon his books, they made a report on the shortage, which was made good, and the bondsmen were immediately discharged. Soon after, when the water rents came due, a number of people were found to have his receipts for dues which had not been credited on the books, but the man's bondsmen had been released, and the town had a considerable sum to charge to profit and loss. A committee went over a lot of old accounts, and found that their predecessors had approved reports in which there were serious defects, but lest they should seem to reflect on the abilities of their friends, the superintendent was instructed to call it square, and open a fresh account with each person whose accounts were found faulty in former reports.

A case recently occurred in a neighboring State, showing how short sighted some councils are in regard to franchises. A company applied for a franchise to furnish light and power from a water power not far away, intending to spend about $30,000 in the plant. After dallying along for some time, the franchise was granted by the council, but vetoed by the mayor, who wanted a municipal plant. Although the town was already within $8,000 of its bond limit, it voted bonds in that amount to build a plant, hoping in some providential way it could put in a plant. In one town where a committee of the council was supposed to keep track of the matters, a superintendent managed to do away with over a thousand lamp renewals in a single year, of which there is no account. Over $300 worth of fixtures sold without record were traced.

The superintendents of municipal plants are often incompetent. The superintendent of one plant where they still use 50 volt transformers, heard of the saving in using large transformers, so he bought one and tried to supply 50 lamps one block distant by a No. 6 wire (assuming one ampere per lamp and 400 feet to the block would give a drop on the line of about 22 volts). The superintendent was sure that No. 6 was large enough, for the insurance rules said it would carry it all right. The trouble was, therefore, in the transformer, and he compelled the agent to trade it for three small ones. The large one "did not regulate" as well as the small ones, and he is sure that the modern idea of large transformers with secondary networks is a mistake and a failure, for he tried it.

In another town of about 4,000 inhabitants, a technically trained superintendent is saving about $6,000 annually above the records of his predecessors. In a smaller town, a similar man is saving between two and three thousand dollars annually to the town on account of more skillful management. He increased the revenue by $100 in a single month by using better transformers and lamps, although the station output was 10 per cent less. The station output was materially lessened by inspection of the circuits and tying up the lines where they had fallen upon the cross arms. Incandescent lamps on flat rates taking 58 to 70 watts, were replaced by 53 watt lamps with marked economy. In another station the superintendent confided to an agent

that he was bothered about learning the frequency of his alternator. The agent said it was too complicated a matter for him to figure off-hand, but he would calculate it when he returned to his office. The agent found that the practice of his own company in similar cases was to use 125 cycles, and he reported that the superintendent had such frequency. As a matter of fact, it was 140, and the speed was marked on the machine. In one town the chief reason why one alderman voted in favor of one system against a lower bid, was that his preference was the machine with "kilowatts," while the cheaper machine was a "multipolar" machine, and he preferred kilowatts to multipolars.

In the laudable endeavor to secure economy, the mayor and council frequently lose at the bung while saving at the spigot. This occurs both in the first purchase of the plant and in its later operation. After one town had voted to put in a lighting plant, the mayor took a trip to learn what he could. After consulting with several agents and getting propositions from them, he called upon an engineer, who was given to understand his services would be required. After spending some hours pumping him, the mayor left and went home, where he concluded that he was enough of an engineer himself to lay out the plant. So he bought some machines, hired a wireman, and the plant was put in. At another place, a resident bought some second-hand machinery, and after putting it in operation, sold it to the town for what it would cost when new. In a few weeks they had to spend about a hundred dollars for repairing the armature, and then had to buy a new machine.

At another place they decided to secure a cheap engineer to design their plant. He specified a 20 horse power gasoline engine to operate a 600-light dynamo, and, in addition, to drive the pumping machinery for the water works. The council made a contract for the gasoline engine as specified, including a proviso that if a steam plant were substituted, the gas engine contractor was to receive a commission of 15 per cent. of the cost of the steam plant. It is reported that this was actually done and paid. Two of the larger towns of the State were contemplating municipal ownership, and each secured the services of an inexperienced young man to prepare plans and specifications for the plant—in one case, because he was a friend or relative of one of the committee; in the other case, probably because he was cheap. The country is full of half-baked electricians who pose as engineers and as advisers to investors.

There is frequently an attempt to reduce operating expenses too far. At one place the council discharged a good engineer and hired another because he was cheap. Within three days he got his cylinder full of water and broke the girder of the Corliss engine. It is common even with a privately owned station to attempt economy by hiring cheap firemen, since any one can shovel coal or throw wood. But owners fail to recognize that by paying ten to twenty dollars more for securing a capable fireman they are apt to save his extra wages several times over in reduced fuel bills.

In some cases there is great loss on account of downright dishonesty of the superintendent or the council committee. A city employing an honest superintendent with liberal pay and some backing in the council, will often prevent small and also large steals which are almost invariably found in municipal departments, such as lamp renewals (on which it is difficult to keep accurate account or check), "rake offs" on purchases for the plant, for which in the end the city pays. One supply company offered a new superintendent as high as 20 per cent. on all purchases the year round, as they had always done so. This is substantiated by old bills. Lamps are checked up once a month while burning, and one is often asked to go easy in counting, being offered all sorts of bribes, from cigars or drinks to considerable sums in cash. Certain officials are known to have received special concessions in this way amounting to several hundred dollars per year. All this could have been prevented by a proper system of checking, but at best comes down to one man being honest. Carloads of wood have been sold "by the car" by former superintendents. An investigation by an alderman indicated that a loss of over $1,000 per year had been received from that source alone. In another place the city recorder is said to collect the accounts, and sometimes sublets the job to his friends, who knock down about half and turn the balance over to the recorder, who in turn transmits to the treasurer so much of it as suits his convenience, there being no records and no other system.

The political conditions prevent best results in many plants. Where the employees are appointed by aldermanic influence, it is not uncommon for an underling to retort to his superior officer when corrected for some shortcoming, "Oh, well, I have more pull than you have, and what are you going to do about it?" In one town, until recently, the plant was operated by two parties, an engineer, who took care of the station, and a lineman, in charge of outside work. These parties were not on speaking terms, and, of course, each attributed all trouble with the lights to the other man's part of the plant. This state of affairs continued for several years, during which time the arc system was in bad condition, the lineman attributing it to the dynamo, and the engineer laying it to the lamps. When a change was made, there were two applicants for lineman; one a good man who would have attended to business, the other was a young son of one of the aldermen, and with little experience or ability. There were also two applicants for fireman; one a good man, and the other a lazy, good-for-nothing fellow, who claimed to have considerable influence in the country, so that he could turn considerable trade to some of the stores in which the aldermen were interested. By combining forces, the poorer man was appointed in each case.

There is a continual struggle between the temperance and the saloon element in most of the towns, and when a new election puts the opposition into power the superintendent is almost sure to lose his place in favor of some friend of the new management. In one town the superintendent had found the station and accounts in very bad shape, and was getting them into fair condition, when the election went "wet." The next day the new mayor informed the superintendent that he would give him any kind of a recommendation he might ask for.

The Lighting of Small Towns.

In a paper on this subject, read by Mr. G. M. Harris, an electrical engineer of Bray, Ireland, before the Municipal Electrical Association, the author said:

The lighting of small towns is a problem requiring very careful consideration, not by reason of any engineering difficulties, but by reason of the difficulty of making such an undertaking pay.

On account of the profits being necessarily small, the lighting of small towns will continue to receive little attention from private companies, except they be very plucky ones. The matter will therefore be left for the consideration of the local authority, who will be content, or at all events should be, if at a reasonable cost they are enabled to carry out the public lighting of the town, and at the same time place a supply of electricity at the disposal of its inhabitants.

The measure of the success of such an undertaking should then be judged, not by actual return made in the shape of profit shown, but upon truly municipal lines, *i. e.*, by the efficiency and cost of the public lighting and the rate at which a supply of electricity is obtainable for private use.

Small towns mean small consumers and usually a scattered area.

The distributing charges will be heavy, so that if there is to be any hope of success the generating charges must be light, which means that the site for a generating station must have very special natural advantages, such as good water power or facilities for cheap fuel, or a combination of the two.

Where there are no such advantages there appears to be no alternative but to wait for the great power companies to pick up such small areas as may be within their reach or upon the direct line of route of their mains to larger ones.

Assuming that the conditions are favorable for generating or obtaining a supply at a low cost—at the commencement the public lighting should be provided for and taken over, and provision only made for private consumers where such are certain to come on in a reasonable time.

The policy of laying the mains for private use well in advance of the demand, though justified in wealthy areas, would not be so in small towns where the conditions are different.

The prospect of profit in supplying small and scattered consumers being very small, there is no room for speculation, and it is of the utmost importance that the capital expenditure be kept as low as possible, and that no capital should be unproductive.

It therefore follows that the system of distribution should possess the maximum of flexibility at the minimum of cost.

Now that distribution up to 200 volts has been successfully established, there are of course many towns where direct current would be feasible and no doubt preferable, but in the majority of cases high pressure alternating current with transformers in street pits and occasionally in houses would be better; where the area comprises a number of private houses and mansions standing in their own grounds and of necessity widely scattered but nevertheless desirable to reach, the alternating system is the only one commercially possible. This

question, however, will of course be governed by the circumstances in any particular district, but the question of the actual cost of mains will always remain—a serious item telling against economical distribution on a small scale.

It is therefore the object of this paper to deal with the matter of cheap mains and main laying, that being, I consider, the most important point, the one which lies nearest towards a solution of the problem under consideration.

I therefore propose to bring to the notice of this association two cheap and effective methods of main laying, of which I have had experience at Bray. First as to the mains in operation at Bray—there have been over 6 miles of high and 27 miles of low tension laid direct in the ground since 1892, and during that time we have never had a fault on the main line of cables themselves, except where mechanical injury had caused it, and this has very seldom happened. Any trouble we have had has been due to defects in the filling material of the jointing boxes, now overcome, so that this system of laying may claim to have been well tried. In fact, I think the Bray mains are the oldest paper insulated cables in the Kingdom, other than those from Deptford.

The cables are concentric lead covered and unarmored. They are taped, but this is, in my opinion, a disadvantage.

In laying, the bottom of the trench was covered with about 3 inches of puddle clay, well wrought, the cables laid in and covered with another 3 inches of puddle clay, evenly put on, and a 7 inch by 1 inch board placed on top, the trench being then filled.

Latterly the timber used for mechanical protection has been larch, being simply the small larch trees, 7 inches thick in the butt, sawn in half; this timber stands well in the ground, requiring no special treatment to preserve it, is cheaper than deal boards and more effective, being thicker. The effect of the puddle clay, impervious to moisture, is to protect the lead covering from any contact with acids or salts in the soil which would attack it, and it has proved so effective that when the cable is now, after 8 years, exposed, the lead is absolutely unattacked.

The braiding of the cables has rotted, proving to have been an unnecessary expense. It might prove a source of danger if it allowed a passage of water charged with matter which would attack lead, the life of a lead covered cable being practically the life of the lead.

As to the jointing, no clips are used; the inners are married and soldered in the usual way, the outer wires are drawn to one side and soldered together forming a loop, all soldering being done well clear of the cable insulation.

The joint is contained in a cast iron joint box divided longitudinally on the line of two bottle necks for entrance and exit of cable and having on the top side a large hole for filling, (not less than 1 inch) and a smaller hole as air vent, closed by screwed plugs. The cables are served with spun-yarn up to the diameter of the bottle necks and no other packing of the glands is found necessary. The joints having been made and the box screwed up, molten pitch is poured in; the outer side of the bottle necks, beyond the spun-yarn serving, is also filled in with pitch, hollows being formed in the clay for the purpose and here fine clay mixed with the pitch forms a cement which effectually seals up the bottle necks and protects the cable from injury where they enter and leave the box. Such a joint is cheaply made and fulfills every requirement.

It demands only care and requires absolutely no special skill, a very important matter in a small town. This and the fact that it is both electrically and mechanically sound, gives a joint so made advantages which no form of joint made with clips, that the writer has seen, can claim.

Where any transformer pits lie on the route all cables are brought into the pits and are joined there, inners and outers, with loops of rubber covered single cables. Disconnection of any length of cable for tracing a fault is done by snipping these loops and this works well under our conditions.

Of course, in a large scheme where the expense was no object, disconnecting boxes would be preferable, but when used they should certainly be placed in pillars above ground, and so above the reach of flooding, and not in water tight boxes under ground.

As far as the writer is aware the insulation resistance of mains in operation is not easily obtainable. This, however, in no way reflects on the cables; it is partly due to the fact that originally oil was used in the joint boxes, but was soon abandoned, not however before the cable ends had suffered, due to water mixing with the oil. The repairing of these ends accounts for the large number of joints. The main cause of the low insulation is due to the large number of joint boxes which still contain a mixture of tar and pitch (the tar having been added as a precaution against cracking of the pitch). This mixture is inferior in every way to the pitch alone which is now always used.

The fact that the resistance from the inner to the outer is in the majority of cases greater than that to the earth is no doubt accounted for at the joints, where the resistance of the pitch has been weakened in the manner indicated, and the surface of the outer is small in comparison to the surrounding box. Their condition, however, causes no anxiety at Bray, as the tests are practically identical with those taken in 1893. The cables have been perfectly steady all along and have lived to see much of the more elaborate and costly draw-in system placed on the scrap heap.

Sufficient has been said perhaps to show that such a system of laying and jointing mains is cheap and reliable in any case in which no danger from electrolytic action is feared—as where for instance a tram line passed through a town—in such a case the lead would need protection, and recourse to some solid system seems inevitable. But a small town cannot afford the luxury of lead covered cables laid in this way, and the lead seems to me quite unnecessary, serving no purposes which would not be equally served by any cheap covering which would protect the insulation from damp up to the time of being laid, after which it requires no such protection.

If the cables are concentric the outer insulation can be reduced to that thickness which, with the filling, suffices for the voltage carried; if the cables are not concentric, then the covering of each may be reduced to that thickness which, with the filling, is good enough.

The question is, how much the insulation, other than that of the filling compound, may be reduced?

My impression is, that driven by consideration of cost, we shall see this extra insulation year by year reduced in amount till, for low voltage, we come to the bare conductor laid on insulators in the solid filling, and for higher voltage, conductors laid on the same system with very slight extra insulation, relying mainly upon the filling compound.

The inevitable result of this will be that we shall, for the conductors, use iron or other metal, or alloy, cheaper than copper, since the prohibitive cost of the increased insulation due to bigger cross section for the same conductivity for such metals, will not have to be faced. At Bray we tested some years ago 80 yards of bare copper mains laid on the solid system, and although roughly laid and badly insulated, the filling compound being a mixture of bitumen, tar and sawdust, this nevertheless stood 1,000 volts for 12 months, and 100 volts for 2 years afterwards, and was then only taken up on account of building extensions.

From that experiment and subsequent experience I believe it is perfectly possible even now for voltage, say up to 500, covering all low tension distribution for light and traction, to use wires covered with say a few layers of paper and a light braiding varnished, and the whole laid in troughing filled in with plain pitch at 10s. per ton, which, for all sizes of copper above, say 0.25 inch sectional area, would be cheaper that any cable in the market.

Whatever be the nature of the solid system, the compound for filling both joints and troughing should be ordinary pitch, which has the advantage that it can with ease be chipped out, and is cheap.

College Bred Men and their Relation to Practical Work.

Dr. Edward Kirk, writing on this topic says: Men are said to be born to command and others born to follow. The college bred young man generally imagines that he is one of those born to command when placed in charge of men; and this is wherein he fails.

Recently while visiting a large malleable iron foundry plant, for the purpose of looking over their cupolas and plan of mixing and melting iron, I was surprised to learn that they did not employ a chemist at their works, and inquired of one of the firm why they did not do so. He said: "Our experienee in employing college bred young men in our works has not been very satisfactory. When we constructed this plant a few years ago we employed a young civil engineer who was highly recommended to lay out the works, make drawings for the various buildings, place machinery, cupolas, furnaces, etc.

"His work in this line was very satisfactory, and he showed such a thorough technical knowledge of foundry practice, in laying out the plant, that, after he was through with this work, we decided to continue him in our employ, by giving him charge of the foundry.

"He had not held this position for more than two weeks before he had quarreled with or offended nearly every man in the foundry, and almost every man in the foundry was opposed to him. We could not get satisfactory results with this condition of affairs existing in our

foundry, and had to let him go, and placed one of our moulders in charge who was more familiar with the ways and ideas of the men and more capable of managing them than the man with the college education.

"This should not have been the case, if there is anything in a scientific education, and would not have been the case had not the college trained man thought himself superior to the mechanics and laborers placed in his charge, and treated them as mere mechanics or trash to do his bidding. This is only too frequently the case with young men educated at colleges when they engage in mechanical pursuits.

"They think mechanics uneducated men, inferior to themselves, which is not the case; for, while he has spent three or four years at college, the mechanic has spent a similar length of time learning his trade, and knows more about it in a practical way than does the college man, who has only gained a theoretical knowledge of mechanical pursuits at college.

"The mechanic knows this, and is ready to resent any action of the college man which tends to assert his superiority as a man or a mechanic."

The young man above referred to is not the only college man learned of having been a failure in managing men, and I might give the experience of quite a number of manufacturers in this line. But I have only met one college bred man who started in with wrong ideas in the management of men that ever made a success of managing them in the works in which he started. This man was a stove founder at Boston, Mass. And it was amusing to hear him tell of his experience before, as he expresses it, he took a "tumble to himself," and in place of thinking the men ignorant fools he discovered he himself was the fool. And had it not been for his father's interest in the works of which he afterwards became owner he would have been kicked into the street both by the men and his employer. "Why," said he, "I thought the men did not know anything, and were a set of fools, and it took me several years to learn my mistake, and several years more to get back where I would have been at the start had I learned at college what I afterwards learned by experience about human nature and the management of men."

The manager or foreman who quarrels with or curses and swears at men or yells at them across the shop, and orders them what to do in the presence of other workmen, is seldom a successful manager or foreman; for such actions are regarded as humiliating by the man spoken to, and arouse a spirit of resentment which is made manifest in a variety of ways against the manager or foreman to the injury of their employers.

Each workman has his friends among his fellow workmen, who sympathize and side with him against such treatment. No matter how much the workman reprimanded may have deserved to be reprimanded, these join with him in getting even with the manager or foreman, and such treatment of men generally results in a general dissatisfaction of workmen, and is sometimes the cause of men quitting at a time when they know their services are most urgently needed, or of strikes resulting in great loss to their employers and themselves.

The successful manager or foreman is the man who thoroughly understands the mechanical pursuits in which he is engaged, and has acquired the knack or science of not driving but leading men to do his bidding. Such a man does not quarrel with his men or do anything to humilate them in the presence of his fellow workmen.

When their work or conduct is not satisfactory, he goes quietly to the workmen and advises or instructs them what to do to improve matters and make affairs satisfactory.

If such instructions or advice are not followed, or the workman is not competent to do the work, he is quietly informed on pay day that his services are no longer required, or is given his time and sent to the office. The disturbing element among workmen, of which there are always a greater or less number in every workshop, are treated in the same way, and everything is done to avoid offending the men and creating a spirit of dissatisfaction among them, which always results in loss to their employers.

The class of men employed in mechanical pursuits, whether mechanics or laborers, are an intelligent class of men, in their line, and like all intelligent men, object to being driven; and while the driving foreman may be a success in handling a gang of ignorant foreign laborers, building a railroad or digging a ditch, he is never a success financially in mechanical pursuits.

The foundry chemist, which I have been advocating as the proper man to be placed in charge of cupolas, and the mixing and melting of irons, should carefully study these points, and should ever remember that every workman, no matter how humble, has his feelings and his friends; and that it is more profitable to lead than to drive, and that when men cannot be led they cannot be driven, and that there are other remedies than quarreling with them. The following rules may lead to the successful management of men in mechanical pursuits if the man has the ability to be a manager.

1. Learn to control your temper under all circumstances.
2. Cultivate a manner of address that will win the respect of the highest or lowest of workmen.
3. Be firm and polite in demeanor, and an ardent student of human nature, that you may win the respect of all men.
4. Cultivate executive ability, and never give up until you have accomplished the end in view.
5. Be sure you are right before you go ahead; it is better to abandon a theory or hobby than to make a failure of it.
6. Be temperate in habits and language.
7. Treat all workmen under your charge with due respect in and out of the shop; but never make companions of them, either out of or in the shop.
8. Always remember that you do not know it all, and cultivate the habit of learning from workmen under your charge, and others, all you can without exposing your own ignorance.
9. Learn to apply such knowledge without giving others credit, and to improve upon it or present it in such a way that the man from whom you obtained the knowledge would not recognize it as his own, and give you credit for knowing more than he did.
10. Never quote one workman to another as authority for anything you want done; be the only authority in the shop yourself.
11. Never try to instruct a workman how to do a job you do not know anything about; first find out if the workman knows how to do the job, and if he does not, give it to another who does, and learn from him how it is done, so you may be able to instruct another.
12. Strive to get the largest possible amount of work done, and well done, by each man, and look after the interest of your employers in all things, for you are employed to make money for your employers, and if you cannot do it they will not require your services very long.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

At the annual meeting of the Delaware Gas Light Company, of Easton, Pa., the officers elected were: Directors, Arthur E. Childs, Alfred Clarke, George F. Blake, Charles H. Cooke, R. E. James, E. J. Fox and J. W. Fox. President, Arthur E. Childs; Vice-President, Alfred Clarke; Treasurer, Chas. H. Cook; Secretary, J. W. Fox.

Mr. Arthur W. Lee, who has for some years been Superintendent of the electrical department of the Portsmouth (N. H.) Gas, Electric Light and Power Company, resigned that post to accept the Superintendency of the municipal lighting plant at Concord, Mass. He assumes his new duties to-day.

The Newtown and Flushing Gas Company, to "manufacture and supply gas for lighting the streets and public buildings of the Borough of Queens," New York, has been incorporated by Messrs. H. R. Wilson, Thomas W. Stevens and Edward J. Patterson. It is capitalized in $300,000.

Mr. Robert Beacham, for many years Superintendent of the Columbia (Pa.) Gas Company, died at his home in Columbia the morning of the 6th inst. He was in his 78th year.

The Philadelphia offices of Messrs. Madeira, Hill & Co., Eastern sales agents for the Penn Gas Coal Company, have been removed to 32 South Broad street, that city.

For the half year ended June 20, 1900, the output of artificial gas by the Indianapolis (Ind.) Gas Company amounted to 125,406,700 cubic feet. The number of meters in use the period named was 11,175.

At the annual meeting of the Milford (Mass.) Gas Light Company the officers elected were: Directors, B. E. Harris, L. H. Cook, I. N. Davis, C. F. Claflin, E. L. Wires, N. B. Johnson, F. J. Dutcher, J. B. Bancroft and G. A. Draper. President, J. B. Bancroft; Treasurer, B. E Harris; Secretary and Auditor, H. C. Tilden.

Ex-Alderman Casper, of Council Bluffs, Iowa, who has for some time been endeavoring to place an opposition gas company in that city, has decided that his scheme is inexpedient.

"The Newport News (Va.) Gas Company, in the week beginning June 25th, gave a series of lectures on gas cookery and the economical use

of the gas range, and the result of the teaching was a very great success to all those concerned with it. The lecture hall was the Casino assembly room, and the lecturess was Mrs. Helen Armstrong, of Chicago. As this was Mrs. Armstrong's second visit to Newport News, the ladies of the city turned out in large numbers to attend the lectures, and they and the Gas Company are to be congratulated over the interest displayed and the results achieved. This method of advertising was very successful, and the Company has reached the point where the day's consumption on fuel account amounts to a very large proportion of its output.—S."

OFFICIAL inspection of the gas supplied in Chattanooga, Tenn., shows the average illuminating power to be equal to 18 75 candles. The ordinance under which the Chattanooga Company works prescribes an illuminating value not less than 16 candles.

MR. PATRICK PHELAN, Clerk of the Village of Glendale, Hamilton County, Ohio, has issued a notification to the effect that sealed proposals will be received by him until noon of August 6th for the privilege and franchise of laying, maintaining and operating pipes and mains in the streets, avenues, alleys and other public places, for the purpose of supplying gas for illuminating, heating and power uses for municipal and private purposes. The gas to be furnished shall be of not less than 16 candle power, and its heating value shall be not less than the equivalent of 550 British thermal units per cubic foot.

THE following inclosure from a correspondent at Evanston, Ills., explains itself: "Recently a deal was completed whereby Mr. D. S. McMullen, President of the Waukegan (Ills.) Gas Light and Fuel Company, retires from the concern. His interest in the Company was purchased by Mr. C. G. Dawes, of Evanston, who was a heavy stock holder in the Washburn-Moen Company. The Dawes interests, Mr. Foster, C. T. Boyington and W. I. Osborne (the last two being original stockholders in the Company) comprise the new corporation. Many changes and improvements are contemplated by the new proprietors, who have command of much capital. The Company has recently purchased a tract of land south of and adjoining the gas plant below the hill, and this with the lot purchased last fall at the north of the plant gives it a large factory property. Among the early improvements contemplated by the Company are the enlargement of the manufacturing plant and the construction of a new gasholder, the one now in use being inadequate to the increasing business. The early fulfillment of the project to furnish the towns south of Waukegan with gas from the local plant will be a fact through the speedy laying of the necessary mains. No changes in the local management are anticipated. Mr. G. F. Goodnow, the Superintendent, and Mr. R. C. Webster, the Office Manager, will in all probability be retained in their positions, which will be gratifying to their many friends."

THE property and franchises of the Alpena (Mich.) Gas Company have been purchased by Detroit capitalists, who propose to rebuild the works. A new selling schedule of $2 per 1,000 cubic feet, with 25 per cent. discount for prompt payment, and a net rate of $1 per 1,000 for gas sold on fuel account, has been adopted. Our correspondent adds that Mr. C. T. Park will likely be retained as Superintendent.

THE Louisville (Ky.) *Times*, of the 12th inst., said: Judge Toney to-day handed down his decision in the litigation between the Louisville Gas Company and the Kentucky Heating Company. He enjoins the Kentucky Heating Company from furnishing illuminating gas. The plaintiff sought to prevent the defendant, the Kentucky Heating Company, from sending through the pipes in Louisville any other than natural gas; that this gas should be used for heating purposes only. The plaintiff also sought to restrain the Kentucky Heating Company from mixing artificial gas with natural gas. Judge Toney held that under the franchise granted it by the Legislature the Kentucky Rock Gas Company could furnish its gas to such cities as desired it, and then only on such conditions as such city might make with the Company. The city ordinance by which the Kentucky Heating Company was allowed to lay its pipes in Louisville restricted it to furnishing gas for heating purposes only. Judge Toney declined to seriously consider the contention of the defendant that it furnished heating gas only, and that its customers made it illuminating gas by using Welsbach burners, and thus furnished light. The court holds, however, that to protect its patrons the Kentucky Heating Company has the right to mix artificial gas with the natural product at seasons of the year when the flow of natural gas is not sufficient to furnish the necessary heat. The defendant attacked the ordinance of the city which limits the introduction of natural gas and restricts it for heating purposes as unreasonable and therefore void. Judge Toney held that the city as one-third owner of stock in the Gas Company had the right to protect its interests. The fact that the city has not proceeded against the defendant for violating the provisions of the ordinance restricting it to the sale of heating gas does not, Judge Toney holds, prevent the Louisville Gas Company from complaining of an infringement of its franchise. The closing paragraphs of the decision are as follows:

"It results from the foregoing views that the prayer of the plaintiff's petition, in so far as it seeks to enjoin the defendant from selling and distributing natural gas or a compound of natural and artificial gas, called 'fuel gas,' for illuminating purposes by the use of the Welsbach burner or other mechanism must be granted, and also the prayer of the petition to restrain the defendant from casting a cloud upon the plaintiff's exclusive right of supplying illuminating gas in the city of Louisville for illuminating and heating purposes must be and is granted. The prayer of the petition seeking other and further injunctive relief is refused. As in granting the relief herein prayed for by the plaintiff only to the extent indicated it necessarily follows that the defendant had under its franchise and the ordinance of the city of Louisville the legal right to sell non-illuminating gas; that is, gas not used for illuminating purposes in the city of Louisville, for heating purposes only, and for this purpose to lay and maintain its pipes in the streets, alleys and public ways of the city, and this being its right under its franchises granted by the Legislature to the Louisville Rock Gas Company, it is on its counter-claim entitled to the relief sought in its prayer to enjoin the plaintiff from casting a cloud on its said franchise as herein defined. Let judgment be prepared accordingly, reserving exceptions to both the plaintiff and defendant." The defendant will take an appeal.

MR. GEORGE W. FARNHAM, Superintendent of the Lowell (Mass.) Gas Light Company, was recently presented by the employees of the Company with a handsome gold headed walking stick and a leather suit case. The presentation was made just prior to his departure for Pittsfield, Me., where his vacation will be passed. Mr. Farnham is, we are happy to add, rapidly recovering from an illness that at one time had many serious symptoms.

THE price of gas in Chelsea, Mass., is to be reduced to $1.35 from $1.50 per 1,000 cubic feet.

THE reorganized Lincoln (Neb.) Gas Company, which is hereafter to be known as the Lincoln Gas and Electric Company, is now controlled by the following officers: Directors, I. M. Raymond, J. C. Van Riper, S. H. Burnham, H. F. Rose, J. C. Tomlinson, J. C. Havemeyer and R. C. Woods; President, I. M. Raymond; Vice-President, J. C. Van Riper; Secretary and Treasurer, J. Craig Havemeyer; Assistant Secretary and Treasurer, Homer Honeywell. The capital stock is $1,500,000.

A CORRESPONDENT, writing from Toledo, Ohio, under date of the 13th inst., says: "Not long ago the Common Council requested City Solicitor Brailey to determine whether or not the franchise of the Toledo Gas Light and Coke Company permitting it to operate its artificial system of gas supply throughout the city was perpetual. Mr. Brailey, having investigated the problem, reported to the Council that the Company's franchise was perpetual, but that under it the city had the right to regulate the rate at which the Company might sell gas for periods of 10 years."

AT the annual meeting of the shareholders in the Welsbach Light Company the Directors chosen were: W. E. Barrows, Samuel T. Bodine, Thos. Dolan, W. W. Gibbs, Randall Morgan, J. F. Ritchie and Walton Clark.

Mr. F. R. BAIN, who has been elected President of the Consumers Gas Company, of Newburgh, N. Y., will be assisted by Mr. C. L. Waring as Treasurer. Mr. B. J. MacDonald, who was succeeded by Mr. Waring, retires from his lengthy and honorable connection with the Company with the best wishes of its former owners and present proprietors.

MR. JOHN R. GRIMES, Chairman of the Committee on Light of Richmond (Va.) City Councils, is greatly in favor of increasing the use of gas in Richmond through the medium of gas ranges, etc. It seems he got his inspiration from a recent visit to Kansas City, Mo., where he recently attended the Bryan Convention as a delegate from his resident city. Of course, his enthusiasm over using gas in ranges, etc., is to be commended, even though it arose at a late day; but if he and his associates in the management of the Richmond City Gas Works had listened "years ago" to the pleadings of Superintendent Knowles, in

respect of the increased use of gas for purposes other than illuminating, he never need have gone to Kansas City for an inspiration in that regard.

THE Clinton Gas Company, of Easthampton, Suffolk County, Long Island, has been incorporated by Messrs. DeWitt C. Talmage, Samuel C. Grimshaw and H. D. Hedges, of Easthampton.

The Market for Gas Securities.

The event of the week in city gas share circles was the special meeting of the shareholders in the Consolidated Company called for Monday last for the purpose of voting on the advisability of increasing the capital stock to the comfortable sum of $80,000,000. The meeting was entirely harmonious, and something over 80 per cent. of the outstanding stock was voted. Consolidated showed quite some strength, sales having been made this afternoon (Friday) at 179¾. Other city shares are dull and strong. There should be some good output of news concerning the local gas situation within a fortnight.

Brooklyn Union keeps moving steadily along, the opening to-day having been reported at 167 to 168, and it is remarkably cheap at that. The result of the election for Directors in the Baltimore Consolidated Company resulted in the success of the regular ticket after a close contest with the interests represented by Mr. Dickey. The stock is dull and lower, being quoted at 53¾ to 54¼. Peoples, of Chicago, is steady. In fact, that remark applies generally to the whole gas share list.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

JULY 23.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$4,595,200	100	179	180
Central Union, Bonds, 5's.	3,000,000	1,000	103½	105
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	115	118
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	305	320
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. .. Bonds, 5's	11,000,000	1,000	104	104½
Northern Union, Bonds, 5's.	1,250,000	1,000	95	97
New York and East River.. Bonds 1st 5's	3,500,000	1,000	109	111
" 1st Con. 5's	1,500,000	..	115	..
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	117	126
Preferred	5,000,000	100	135	145
Bonds, 1st Mortgage, 5's	1,500,000	1,000	110	114
Yonkers	299,650	500	180	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	167	168
" " Bonds (5's)	15 000,000	1,000	118	119
Bay State	50,000,000	50	1½	1¾
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	..	35
" 1st Mtg. 5's	475,000	1,000	96½	99½
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	4	5¼
" " Bonds, 5's	5,250,000	1,000	64	67
Central San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,207,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	60	65
Preferred	3,026,500	100	84	86
Consumers, Jersey City Bonds	600,000	1,000	102	105
Cincinnati G. & C. Co.	8,500,000	100	300¾	301
Consumers, Toronto	1,700,000	50	230	235
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	11,000,000	100	53¾	54¼
Mortgage, 6's	3,000,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	113
Consolidated Gas Co. of N.J.	1,000,000	100	12½	15
" Con. Mtg. 5's	380,000	1,000	82	86
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,560,000	50	95¾	96
" Prior Lien 5's	4,598,000	1,000	99¼	100
Detroit Gas Co., 5's	395,000	1,000	100	101
" Inc. 5's	16,000	100	100½	101
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	35	40
Fort Wayne	2,000,000	..	35	41
" Bonds	2,000,000	..	60	64
Grand Rapids Gas Lt. Co..	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	..
Hartford	750,000	25	..	220
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	95	100
" Bonds, 6's	2 650,000	..	100	104
Jackson Gas Co.	250,000	50	70	75
" 1st Mtg. 5's	250,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,322,000	1,000	101½	103
Laclede, St. Louis	7,500,000	100	74¼	75¼
Preferred	2,500,000	100	98	100
Bonds	10,000,000	1,000	110	110½
Lafayette Gas Co., Ind.	1,000,000	100	35	40
Bonds	1,000,000	1,000	60	65
Louisville	2,370,000	50	106	..
Madison Gas & Elec. Co.	400,000	100	70	75
" 1st Mtg. 6's	350,000	1,000	102½	108
Montreal, Canada	2,000,000	100	182	184¾
Newark, N. J., Con. Gas Co Bonds, 6's	6,000,000	..	..	55
	4,000,000	..	..	103
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	98¾	99
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	111⅜	111¼x
2d "	2,500,000	1,000	104	105
Rochester Gas & Elec. Co.. Preferred	2,150,000	50	88	..
	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	47¼	47½
St. Paul Gas Light Co.	1,500,000	100	57½	58½
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,428,000	1,000	88	90¾
St. Joseph Gas Co.	1,000,000	100	42	44
" 1st Mtg. 5's	750,000	1,000	96½	98
Syracuse, N. Y.	1,750,000	100	14	15
Bonds	1,612 000	1,000	86½	93
Washington, D. C	2,600,000	20	270	271
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	100	95	98
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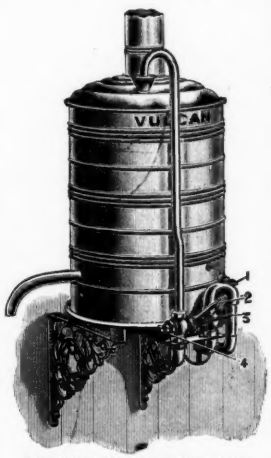

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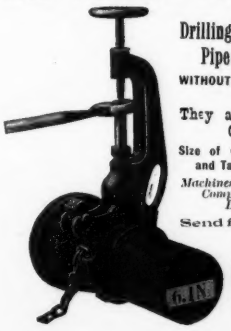

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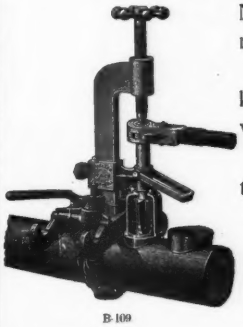

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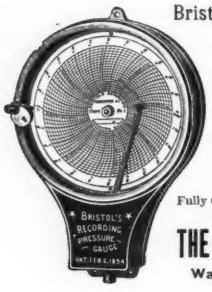

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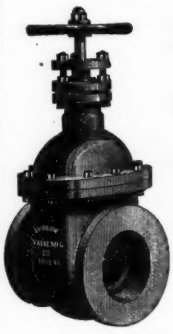

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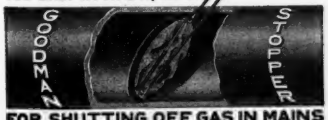

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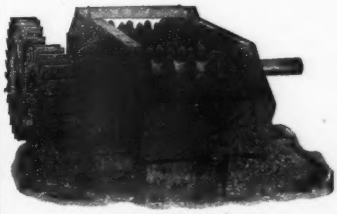

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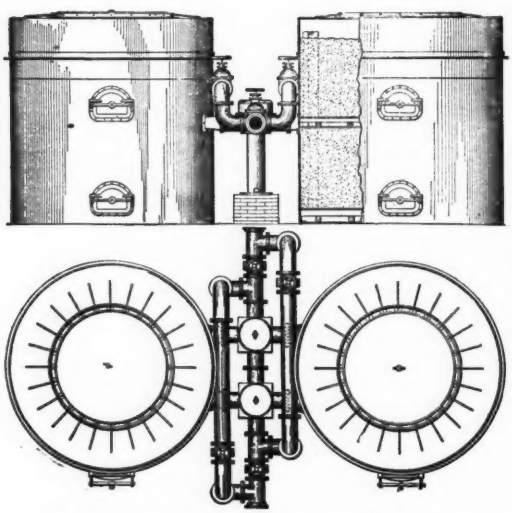

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For the Year 1899.

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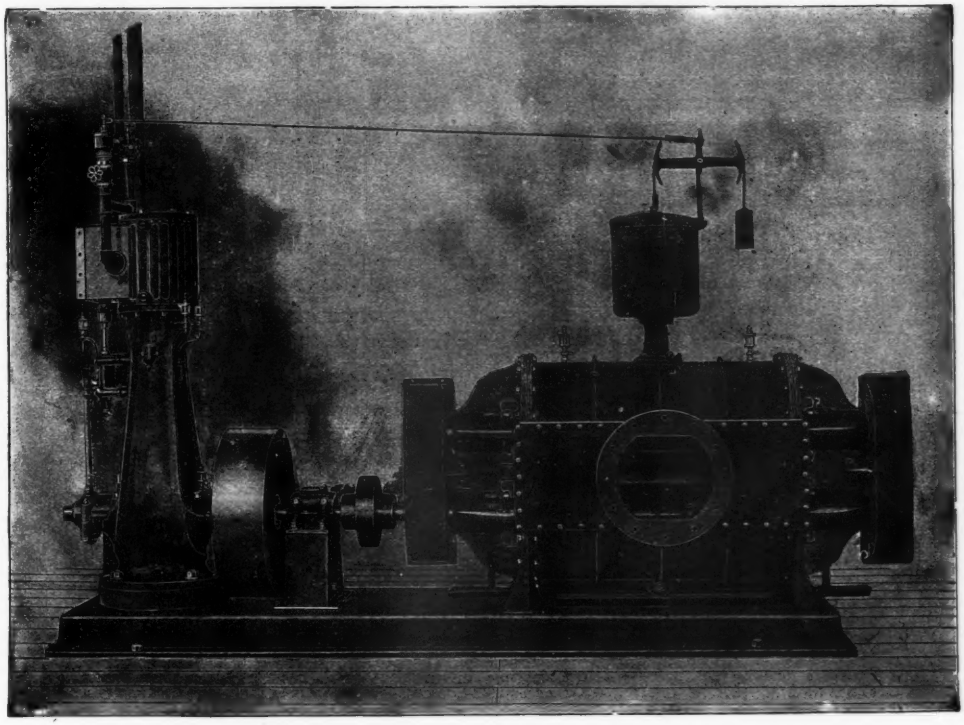

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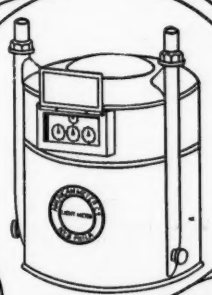

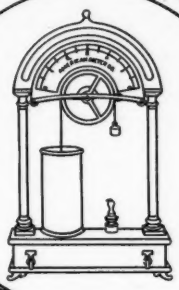

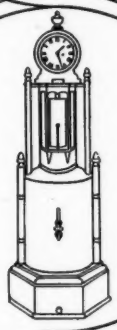

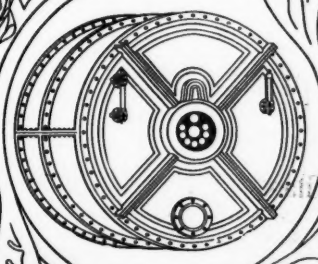

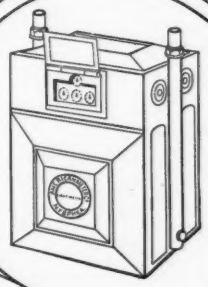

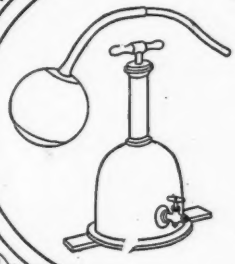

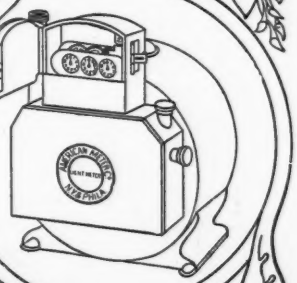

PUBLIC LIGHTING TABLE.

AUGUST, 1900.

Day of Week.	Table No. 1. FOLLOWING THE MOON. Date.	Light.	Extinguish.	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Light.	Extinguish.
				P.M.	A.M.
Wed.	1	8.50 PM	4.00 AM	7.10	3.30
Thu.	2	9.20	4.00	7.10	3.30
Fri.	3	10.00 FQ	4.00	7.10	3.30
Sat.	4	10.40	4.00	7.10	3.30
Sun.	5	11.30	4.10	7.10	3.30
Mon.	6	12.20 AM	4.10	7.10	3.45
Tue.	7	1.30	4.10	7.10	3.45
Wed.	8	2.30	4.10	7.10	3.45
Thu.	9	No L.	No L.	7.10	3.45
Fri.	10	No L. FM	No L.	7.10	3.45
Sat.	11	No L.	No L.	7.10	3.45
Sun.	12	7.30 PM	8.50 PM	7.10	3.45
Mon.	13	7.30	9.20	6.55	4.00
Tue.	14	7.30	10.00	6.55	4.00
Wed.	15	7.30	10.30	6.55	4.00
Thu.	16	7.30 LQ	11.20	6.55	4.00
Fri.	17	7.30	12.00	6.55	4.00
Sat.	18	7.30	12.50 AM	6.55	4.00
Sun.	19	7.20	1.50	6.55	4.00
Mon.	20	7.20	2.50	6.45	4.10
Tue.	21	7.20	4.20	6.45	4.10
Wed.	22	7.20	4.20	6.45	4.10
Thu.	23	7.20	4.20	6.45	4.10
Fri.	24	7.20 NM	4.20	6.45	4.10
Sat.	25	7.20	4.20	6.45	4.10
Sun.	26	7.10	4.20	6.45	4.10
Mon.	27	7.10	4.20	6.30	4.20
Tue.	28	7.10	4.20	6.30	4.20
Wed.	29	7.20	4.20	6.30	4.20
Thu.	30	8.00	4.20	6.30	4.20
Fri.	31	8.40	4.20	6.30	4.20

TOTAL HOURS LIGHTING DURING 1900.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	230.50	January	423.20
February	175.40	February	355.25
March	189.00	March	355.35
April	160.30	April	298.50
May	150.40	May	264.50
June	137.00	June	234.25
July	152.00	July	243.45
August	171.50	August	280.25
September	187.20	September	321.15
October	213.10	October	374.30
November	221.50	November	401.40
December	231.50	December	433.45
Total, yr.	2221.40	Total, yr.	3987.45

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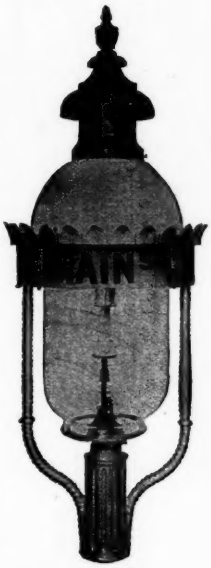

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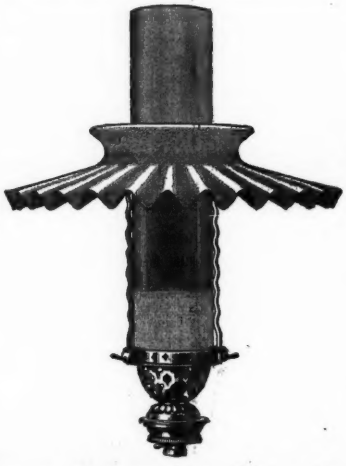

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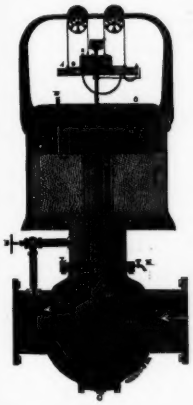

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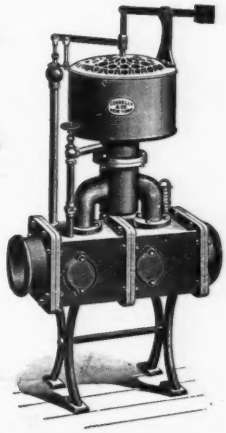

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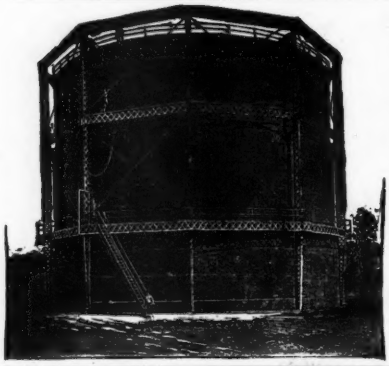

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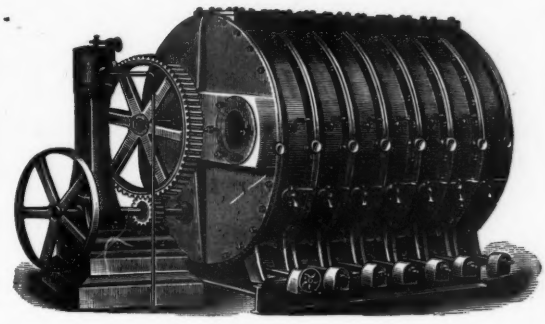

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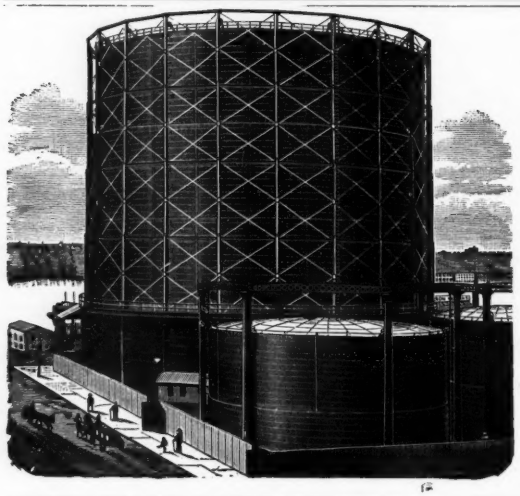

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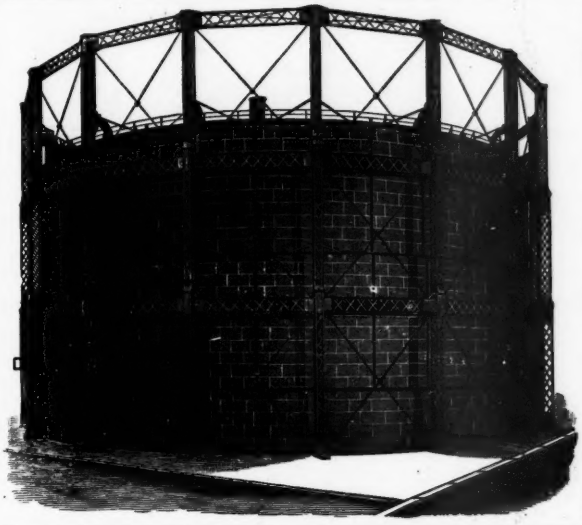

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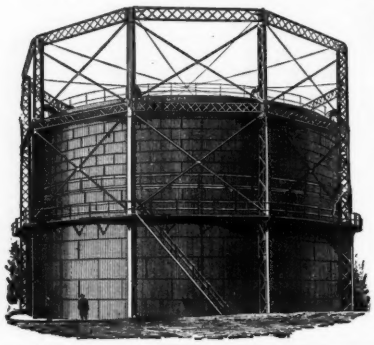

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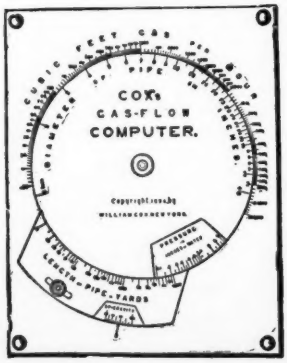

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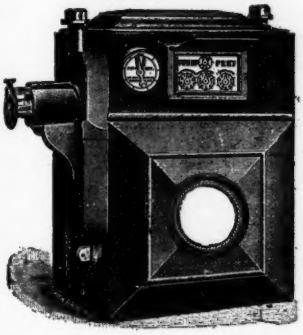

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